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DEPARTMENT OF ENVIRONMENTAL PROTECTION

ENVIRONMENTAL REGULATION

DIVISION OF ENVIRONMENTAL SAFETY AND HEALTH

COMMISSION ON RADIATION PROTECTION

Radiation Protection Programs

Proposed Amendments **N.J.A.C. 7:28-1.4, 2.1, 2.2, 3.2, 3.5, 3.8, 3.10, 3.13, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.11, 4.12, 4.14, 4.15, 4.16, 4.18, 4.19, 6.2, 6.5, 6.6, 7.1, 9.4, 10.9, 11.2, 11.3, 11.7, 13.1, and 13.2**

Authorized By: Bradley M. Campbell,
Commissioner,
Department of
Environmental Protection

Julie K. Timins, M.D.,
Chair,
Commission on Radiation
Protection

Authority: N.J.S.A. 13:1B-1 et seq., 13:1D-1 et seq. and 26:2D-1 et seq.

DEP Docket Number: 08-04-04/317

Calendar Reference: See Summary below for explanation of exception to calendar requirement

Proposal Number:

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Submit written comments no later than 60 days after publication to:

Alice Previte, Esq.
Attn: DEP Docket Number 08-04-04/317
New Jersey Department of Environmental Protection
Office of Legal Affairs
P.O. Box 402
Trenton, New Jersey 08625-0402

The Department strongly recommends that commenters submit comments on diskettes as well as on paper. Please submit 3 1/2 inch diskettes. The Department will be able to upload the comments onto its office automation equipment, thereby saving the Department considerable time in not having to retype the comments. The Department will use the paper version of the comments to ensure that the uploading was accomplished successfully. Submission of the disk is not a requirement. The Department will accept all comments submitted in writing prior to the end of the comment period.

The Department prefers Microsoft Word 6.0 or above; however, other word processing software which can also be read or used by Microsoft Word 6.0 is acceptable. Macintosh formats should not be used.

Text enhancements such as underlines, bold, etc., are often not converted from one software to another. Therefore, when suggesting text revisions involving additions/deletions, the revised text should be presented without enhancements, as it would appear in the rule.

Comments on the summary should be included with the comments on the pertinent section of the rule text wherever possible to eliminate duplicate comments and facilitate the Department's task in organizing and responding to comments. Since comments will be sorted electronically, the following format should be used for each comment:

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Citation (tab) COMMENT: Comment text. (Company name). For example: 7:28-1.4(b) COMMENT: The definition of adult is in error. (ABC Corporation)

The agency proposal follows:

SUMMARY

Background

In 1958, the Radiation Protection Act (the Act), N.J.S.A. 26:2D-1 et seq was enacted. The Act regulates the possession, handling, and use of sources of radiation within the State of New Jersey. The Act established a State Commission on Radiation Protection (the Commission) in the Department of Environmental Protection (the Department) to promulgate rules to prohibit unnecessary radiation which would "... be or tend to be injurious or dangerous to the health of the people or the industrial or agricultural potential of the State, or to the ecology of the State and its wildlife." Additionally the Act, at N.J.S.A. 26:2D-9(l), authorizes the Department to establish and charge fees for the services it performs under the Act. These fees have been established in previous rulemakings and have reflected the actual or projected expenses incurred by the Department in performing those activities.

The State of New Jersey has a long history of regulating sources of radiation. The first radiation protection regulations were adopted at N.J.A.C. 7:28, on December 31, 1952 as part of the State Sanitary Code. At that time, the program addressed the operation of fluoroscopic shoe fitting machines. The Radiological Health Program (the Program) was established in March of 1955 to make measurements of background radiation. The Commission was established in 1958. Also in that year, the registration of X-ray machines began. Regulations implementing the Act were first promulgated in 1960 and the Program began registering possessors of naturally

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occurring or accelerator produced radioactive materials (NARM). Accelerators use magnetic and electric fields to impart large kinetic energy to charged particles such as electrons, protons, deuterons and helium ions. These particles bombard a 'target' element, which transforms it into a radionuclide. Naturally occurring radioactive materials (NORM) include uranium, thorium, and radium and their progeny. These radionuclides are present in rocks, soil, and groundwater and are part of the earth's natural environment. When any human activity increases the concentration of NORM or increases the potential for human exposure, they are then referred to as technologically enhanced radioactive materials (TENORM).

New Jersey has a very comprehensive radiation protection program encompassing x-ray machines, NARM, radon, clean up of radioactively contaminated sites, monitoring around nuclear power plants, emergency preparedness and response to radiological incidents including transportation accidents, and requirements for non-ionizing sources of radiation. Additionally, there are requirements for licensure and certification of people – radiologic technologists, nuclear medicine technologists, radon testers and mitigators, and qualified medical physicists. There is only one area where New Jersey relies on the federal government to regulate – and that is with Atomic Energy Act (AEA) radioactive material. The United States Nuclear Regulatory Commission (NRC) regulates these AEA materials which are source, special nuclear, and byproduct radioactive materials. States have the option to assume responsibility for regulation of radioactive materials that are governed under the federal AEA through an agreement between the Governor of the State and the NRC. The Department has decided to explore Agreement State status with the NRC. One of the steps to becoming an Agreement State is for the NRC to determine that the State regulations concerning source, special nuclear and byproduct radioactive materials are compatible with the NRC regulations and are adequate to protect public health and safety. Many of the revisions in this proposal were made in order to become more compatible with the NRC regulations, and to demonstrate that New Jersey has an adequate radiation protection program.

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Currently, thirty-three states have exercised the option to become Agreement States. These Agreement States issue licenses to users of AEA materials. Approximately seventy-five percent of the nation's radioactive materials licenses are issued through Agreement States. With the expectation of two additional States signing agreements by FY 2004, Agreement State licenses soon may comprise over eighty percent of the national total.

This shift in responsibility has significant implications for the NRC, Agreement States, and most of all, Non-Agreement States (like New Jersey). The NRC has maintained a program that supports the national infrastructure. Particular emphasis is placed on rulemaking and guidance development activities, information technology systems, technical support, event follow-up, and an Integrated Materials Performance Evaluation Program. Since the NRC is currently ninety-six percent fee funded, the continuation of these activities have a fee impact on the increasingly smaller number of NRC licensees. The remaining twenty percent of the licensees from the Non-Agreement states must support the entire infrastructure unless some changes are made.

The NRC's final rule on annual fees for FY 2003 reflected this trend. Some fees declined for non-Agreement State licensees, but for others there was a substantial increase. This was due to an increase in NRC resources needed for the particular type of license and/or because of a reduction in the number of licenses in that category. The NRC also assessed fees to non-Agreement State licensees to recover the costs of types of work including oversight of Agreement States, international activities and work with other Federal Agencies like the Environmental Protection Agency and the Department of Energy, that do not directly benefit the licensees. The NRC lacks the authority to impose fees on Agreement States and their licensees. Although the NRC has reengineered to try to control the costs of processing licenses, they are still faced with escalating costs and fewer licensees to support the regulatory burden.

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In light of the foregoing, the Department is seeking comment from the AEA radioactive materials and State radioactive materials licensees in New Jersey on the Department's intention of pursuing Agreement State status. The Department believes that it would be a benefit to licensees who possess both NRC and State licenses in that it would eliminate dual regulation of certain aspects of their radioactive materials programs. The Department also believes that the fees charged to licensees of AEA radioactive materials in New Jersey would decrease from the current NRC fees if New Jersey were to become an Agreement State because these licensees would no longer be subsidizing the NRC's radioactive materials program.

Proposed Amendments

The Department's rule proposal provides for a 60-day comment period, and therefore, pursuant to N.J.A.C. 1:30-3.3(a)5, is not subject to the provisions of N.J.A.C. 1:30-3 and 3.2 governing rulemaking calendars.

The Commission and the Department have determined that several sections in the Radiation Protection Code (the Code), codified at N.J.A.C. 7:28-1 et seq. are outdated, and need to be amended in order to ensure that the health and safety of the public are adequately protected. The proposed amendments are intended to make the Code consistent with modern-day radiation protection principles, as well as compatible with NRC regulations, where applicable. The major changes to the Code, which are proposed herein, are as follows:

Reduction of Public Dose

Certain sections of the Code were written in the early 1960's and have not been revised even though the science of radiation protection (i.e. determining doses to individuals) has improved. For example, the proposed revisions to Subchapter 6 would decrease the current

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allowable dose to the public of 500 millirems per year (mrem/y) by four fifths. This would bring New Jersey's allowable dose to the public in accordance with the NRC's current regulations at 10 CFR 20.1301. It would also conform with the National Council on Radiation Protection's (NCRP) recommendation that continuous exposure of members of the public be limited to an annual effective dose of 1 millisievert (100 millirems). Accordingly, the Commission and the Department are proposing to amend N.J.A.C. 7:28-6.2(a)1 to reduce the allowable public dose of radiation from 500 mrems to 100 mrems per year.

The Commission and the Department are proposing to recodify the current N.J.A.C. 7:28-6.2 (b) as N.J.A.C. 7:28-6.2(a)2. The requirement, which limits the dose rate to 2 mrem in any one hour in any unrestricted area in the proposed N.J.A.C. 7:28-6.2(a)2, is in the current regulations, but was reworded to be compatible with the current NRC regulations.

The Commission and the Department are also proposing to amend N.J.A.C. 7:28-6.2 (b), (c), (d), (e), and (f), all of which were either revised or added so that the State regulations would be compatible with the NRC regulations should the Department decide to become an Agreement State. Proposed N.J.A.C. 7:28-6.2(b) specifically states that even if members of the public are allowed into a controlled area, they are still restricted to 100 mrem/y. Proposed N.J.A.C. 7:28-6.2 (c) allows visitors to patients that cannot be released from the hospital to receive a dose in excess of 100 mrem/y as long as the dose received does not exceed 500 mrem/y and that the visit is authorized by the radioactive materials user. Proposed N.J.A.C. 7:28-6.2 (d) allows a licensee to apply to the Department for permission to continue operations up to 500 mrem/y. The Department, upon recommendation from the Commission, may approve the application, provided that certain conditions are met, such as demonstrating need, providing a description of the program in place to monitor the public dose, and following procedures to maintain the dose as low as reasonably achievable. Proposed N.J.A.C. 7:28-6.2 (e) requires that all transportation of radioactive materials must comply with all US Department of Transportation regulations.

Proposed N.J.A.C. 7:28-6.2 (f) allows the Department to impose additional restrictions to limit collective dose through license conditions. Collective dose is the dose received by an individual from various sources. This provision applies in situations where there is more than one State licensee affecting the same population.

Revised Discharge Limits

The Commission and the Department are also proposing to revise the limits on discharges of radioactive materials to sanitary sewer systems by State licensees to reflect the current NRC standards that are applicable to federal radioactive material licensees. N.J.A.C. 7:28-11.2 (a) proposes limits that would apply to State licensees, which are hospitals, research facilities, pharmaceutical companies, and currently include several community water systems that are treating drinking water for radium. Southern New Jersey has elevated radium-226 and radium-228 in the groundwater from naturally occurring sources. (See Szabo, Zoltan and dePaul, V.T., 1998, *Radium-226 and Radium-228 in shallow ground water, southern New Jersey*: U.S. Geological Survey Fact Sheet, FS-062-98.) Recently it was discovered that radium-224 is also prevalent in southern New Jersey (see Bahman Parsa's 1998 article, "Contribution of Short-lived Radionuclides to Alpha-Particle Radioactivity in Drinking Water and Their Impact on the Safe Drinking Water Act Regulations" in *Radioactivity & Radiochemistry*, Vol.9, No.4).

In 1983 the Drinking Water Quality Institute (DWQI) was established pursuant to amendments to N.J.S.A. 58:12A-1 et seq, (the Safe Drinking Water Act). The DWQI consists of six ex officio and nine appointed members, whose purpose is to advise the Department on drinking water issues. Based on the recommendations from the DWQI, the Department previously revised its regulations for laboratory certification at N.J.A.C. 7:18-1 et seq. to require that the gross alpha analysis be performed within forty-eight hours of collection. A gross alpha analysis is a screening measurement designed to detect if alpha-emitting radionuclides, including radium, are present in the drinking water. Because of the short holding time before analysis is

required, the Department's gross alpha method captures the contributions from the short-lived radium-224. The outcome of this new methodology is that more public water suppliers are now out of compliance with the gross alpha Maximum Contaminant Level (MCL) set by the US Environmental Protection Agency (EPA) at 40 CFR 141.66. This means that more community and non-community water systems will have to provide treatment for radium. Several of the systems available for treating radium in drinking water produce a radiologically-concentrated waste water containing TENORM that is discharged to the sanitary sewer system. The proposed concentration limits for release to a sanitary sewer at Table 2 of the Appendix of Subchapter 11 would apply to these water treatment facilities, as well as to hospitals, pharmaceutical companies, research facilities and universities. Currently, the Department's discharge limits for sanitary sewers are less protective than the NRC limits. Therefore, the Commission and the Department are proposing to amend the limits to be compatible with the NRC limits, which is required should the Department decide to become an Agreement State.

Proposed N.J.A.C. 7:28-11.2 (b) specifies that excreta from individuals undergoing medical diagnosis or therapy are not subject to the proposed limits set forth in Table 2 of the Appendix of Subchapter 11.

Proposed N.J.A.C. 7:28-11.2 (c) limits the allowable discharge to the sanitary sewer system for radium, thorium, uranium and their progeny, to that allowed under Table 1 of the Appendix to Subchapter 11 for State licensees that discharge TENORM, other than water treatment facilities. The standards applicable to State licensees who discharge TENORM into a sanitary sewer system are proposed to be ten percent of the limits set forth at proposed Table 2 of the Appendix of Subchapter 11. This proposed standard would make the discharge limits equal to those allowable by State licensees for liquid effluent into the State's waters as set forth in proposed Table 1 of the Appendix of Subchapter 11. These liquid effluent limits were derived by the NRC by taking the most restrictive occupational oral ingestion annual limit on intake, and

dividing by a factor of 7.3×10^7 milliliters (ml). The factor of 7.3×10^7 ml was derived by multiplying by a factor of 50 to relate the 5-rem annual occupational dose limit to the 0.1-rem limit for members of the public; multiplying by a factor of 2 to adjust the occupational values (derived for adults) so that they are applicable to other age groups, and multiplying by a factor of 7.3×10^5 ml which is the annual water intake of "Reference Man". "Reference Man" is a hypothetical "average" adult person with the anatomical and physiological characteristics defined in Report No. 23 of the International Commission on Radiological Protection. The Commission and the Department are basing this part of the proposal on the results of the Interagency Steering Committee on Radiation Standards (ISCORS), Sewage Sludge Subcommittee's Dose Modeling Report which shows that TENORM loading in sludge is more of a concern than Atomic Energy Act radioactive materials or accelerator-produced radioactive materials, particularly when the sludge or ash is land applied for many years. Under the proposal, for the reasons stated below, water treatment facilities will still be able to discharge up to the limits in Table 2 of the Appendix to Subchapter 11.

By limiting the amount of radioactive material discharged into sanitary sewers from State licensees that discharge TENORM, with the exception of water treatment facilities, there will be a decrease in the concentration of radionuclides in sewage sludge and ash. Radionuclides, particularly radium, concentrate in sewage sludge and ash and may build up in the soil to levels above the unrestricted use standards specified in N.J.A.C. 7:28-12.9 if this sludge and ash is land applied for many years. Since New Jersey has naturally high levels of radium in groundwater, water treatment facilities are required to treat for radium and some of these treatment systems discharge waste water that is concentrated in radium to the sanitary sewer system. By reducing the amount of TENORM discharged to the sanitary sewer system from TENORM industries, radium loading of the sludge can be limited, which may diminish future contamination problems of land that has had sludge applied. Water treatment plants would still be allowed to discharge to

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the sanitary sewer system as long as the concentration of TENORM in the waste water meets the limits in Table 2 of the Appendix to Subchapter 11.

Revised Licensing Exemptions

There is currently a gap in the regulations between cleanup standards for TENORM in N.J.A.C. 7:28-12 et seq and licensing requirements in N.J.A.C. 7:28-4 et seq. The current licensure regulations do not make a distinction between NORM and TENORM. TENORM is defined as NORM whose radionuclide concentrations or potential for human exposure have been increased by any human activity. NORM is currently exempt from licensure if it is below 1000 picocuries per gram (pCi/g), however, it would be difficult to find NORM, that was not technologically enhanced, at such high concentration in New Jersey. The soil remediation standards for radioactive materials for unrestricted use at N.J.A.C. 7:28-12.9 are two to three orders of magnitude below 1000 pCi/g for radionuclides in the natural decay series. The Commission and the Department are proposing to close the gap between licensure and cleanup to be more protective of public health by licensing facilities that process TENORM above 5 pCi/g in order to constrain certain aspects of operations such as proper discharges to air, water, and sewer, proper waste disposal practices, and proper site closure at the time that operations cease. It is expected that enforcement of license conditions will prevent the creation of contaminated sites in the future. Accordingly, the Commission and the Department are proposing to amend N.J.A.C. 7:28-4.3(a)5 to exempt NORM that has not been technologically enhanced, to delete the reference to a concentration of 1000 pCi/g, and to add a new 7:28-4.3(a)6 to reduce the licensing exemption for TENORM from 1000 pCi/g to 5 pCi/g of Radium-226 and Radium-228 combined.

Proposed N.J.A.C. 7:28-4.3(a)7 exempts radon gas that is being expelled to the outside atmosphere as part of a radon remediation system installed in accordance with the provisions of N.J.A.C. 7:28-27. The Commission and the Department believe that there is no adverse

environmental or public health effect from operation of radon remediation systems from the radon that is released to the atmosphere.

Proposed N.J.A.C. 7:28-4.3(a)8 exempts owners of sanitary sewer systems where residuals are present which may contain TENORM from the separation of liquids and solids which is the outcome of the normal operations of the sanitary sewer system.

Proposed N.J.A.C. 7:28-4.3(a)9 exempts owners who distribute, use or possess fertilizers containing TENORM.

Proposed N.J.A.C. 7:28-4.3(a)10 exempts owners of property where residual contamination remains at a site that was remediated under the jurisdiction of the Industrial Site Recovery Act (N.J.S.A. 13:1K-6 et seq.). Concentrations above 5 pCi/g Ra-226 and Ra-228 could be present if the site was released under restricted conditions which would require institutional and/or engineering controls.

Increase in Staffing (Fees)

The radioactive materials section is currently understaffed. The Department based this conclusion on its review of the staffing and workload of the radioactive materials section and the Conference of Radiation Control Program Directors (CRCPD) publication #82-2, *Criteria for Adequate Radiation Control Programs (Radioactive Materials)*. CRCPD's staffing analysis did not even consider the added responsibilities of emergency preparedness since the events of September 11, 2001. The radioactive materials section is spending a considerable amount of time preparing plans for response in case of a terrorist attack involving radioactive materials. There has also been an increase in the number of responses involving radiation alarms installed at trash and recycling facilities. Since the Act gives the Department the authority to establish and charge fees for any of the services it performs, an approximately sixty percent increase in

fees is being proposed to cover the cost of additional personnel necessary to perform the duties of a fully functional radioactive materials program. Accordingly, the Department and the Commission are proposing to amend N.J.A.C. 7:28-3.13(a) to increase the fees for radioactive materials registrants and N.J.A.C. 7:28-4.19(a) to increase the annual license fees to be paid by State radioactive materials licensees. Details of how the sixty percent increase was calculated are provided in the Economic Impact Statement below.

Additional Proposed Amendments

In addition to the major revisions addressed above, the Commission and the Department are proposing to amend the following:

1. New and revised definitions have been added in N.J.A.C. 7:28-1 to address the terms that are used in the proposed amendments. "Occupational dose" has been revised to mean the dose received by an individual in any area, not just a controlled area, and from any radioactive material or machine source, whether licensed or unlicensed.

2. In order to clarify the current regulations, a distinction was made between State licensee and licensee in the definition section N.J.A.C. 7:28-1.4(a). A State licensee refers to a person who is required to obtain a license from the Department for the manufacture, production, transfer, distribution, arrangement for distribution, sale, lease, receipt, acquisition, ownership, possession or use of NARM, including TENORM. A licensee is a person who is required to obtain a license from the NRC or from another State other than New Jersey.

3. In order to clarify the current regulations, a distinction was made between registrant, meaning machine source registrant, and Radioactive Materials registrant, meaning an NRC licensee who is required to register with the Department, in the definition section N.J.A.C. 7:28-1.4(b).

4. A clarification was added to N.J.A.C. 7:28-3.13(h) and to N.J.A.C. 7:28-4.19(f) stating that fees submitted to the Department are non-refundable.

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5. The subchapter at N.J.A.C. 7:28-4 is proposed to be amended to include a requirement for State licensure for any person that manufactures, distributes, or arranges for the distribution, sells or leases NARM. The Department has had experience with persons performing certain activities with radioactive materials who are not licensed only because the current licensure requirements were not drafted broadly enough to trigger licensure. By expanding the list of activities that will trigger the licensure requirement, the Commission and the Department believe they will now cover persons who should otherwise have had a State license. Without a State license, the Department does not know whether there is a knowledgeable person available to answer questions related to possible contamination of workers and the workplace, or patient overexposures.

6. The Commission and the Department are proposing to delete N.J.A.C. 7:28-4.3(a)6. because an exemption process is already outlined in N.J.A.C. 7:28-2.8.

7. The exempt concentration table in N.J.A.C. 7:28-4.3(b) has been revised and expanded based on the NRC's exempt concentration table. Some NARM nuclides were not included in the NRC table, so the Department determined that multiplying the most restrictive release concentrations specified in 10 CFR 20 Appendix B, Table 2, (Column 1 or 2) by twenty was consistent with the values obtained by the NRC for nuclides that were listed in the exempt concentration table.

8. Subchapter 4 was amended at N.J.A.C. 7:28-4.3(c) to clarify that quantities below those requiring a general license are exempt quantities.

9. The section on license termination, N.J.A.C. 7:28-4.16(c), has been revised to require demonstration that the site meets the cleanup standards at N.J.A.C. 7:28-12 (adopted on August 7, 2000). This amendment clarifies that the decommissioning standard for State licensees is the same as the soil cleanup standard for contaminated sites.

10. The Non-Occupational maximum permissible average concentrations of radioactive materials in air and water was deleted from N.J.A.C. 7:28-6.5(a), revised and moved

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to Table 1 of the Appendix in Subchapter 11. These revisions were made to be compatible with the NRC regulations should the Department decide to become an Agreement State.

11. In order to be compatible with the NRC regulations at 10 CFR 20.1208, N.J.A.C. 7:28-6.6(a) through (d) are being added to include restrictions on the allowable dose to the declared pregnant worker.

12. In order to be compatible with the NRC regulations at 10 CFR Appendix C to Part 20, the existing table at N.J.A.C. 7:28-10.9(a) was deleted and replaced with a new table which lists the quantities of radioactive material, including TENORM, that is subject to labeling and posting requirements. Generally speaking, the values in the proposed table are higher than in the current regulations. However, some values are the same and some are lower. This does not affect members of the public or the environment, since none of these quantities are allowed to be released or disposed of into the environment. The purpose of amending this table is to be compatible with the NRC should New Jersey decide to become an Agreement State. The title of the Subchapter was amended to delete the reference to disposal because these requirements do not apply to disposal. Rather, Subchapter 11 has requirements for disposal.

13. The Commission and the Department are proposing to amend N.J.A.C. 7:28-11.3(a) which allows State licensees to discharge radioactive materials to the air and water at the proposed limits of Table 1 of the Appendix. The limits in Table 1 are consistent with the NRC effluent concentrations. Generally speaking, the values in the proposed table are more restrictive than those in the existing table.

14. The Commission and the Department are proposing to amend N.J.A.C. 7:28-11.3(b) to specify that the State licensee shall not dispose of State-licensed, or any other radioactive materials into the surface or ground waters without specific, prior permission in writing, in the form of a New Jersey Pollutant Discharge Elimination System permit, from the Department.

15. N.J.A.C. 7:28-13 addresses reports of thefts and radiation incidents. The proposed amendments would clarify who is responsible for submitting a report and how to

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submit it. The proposed ammendment to N.J.A.C. 7:28-13.1 expands the obligation to report to radioactive materials registrants.

Social Impact

Reduction in Public Dose

There will be a positive social impact from these proposed revisions due to the reduction in allowable radiation exposure to members of the general public. Current State regulations set a limit on radiation exposure to the general public that is five times the federal limit. The proposed revisions would lower the exposure limit for members of the general public and bring the State in line with current federal limits. Current scientific knowledge holds that reduction in radiation exposure reduces an individual's risk of developing cancer.

Revised Discharge Limits

Many industries utilize mineral ores and materials which may contain TENORM. These materials may be present in the mineral molecular structure, as a containment coating mineral grains, or as radioactive minerals included in the raw material for an industrial practice. These radionuclides may become concentrated in solid or liquid form. The following industries are known to have TENORM contamination potential: paper and pulp facilities; ceramics manufacturers; paint and pigment manufacturers; metal foundry facilities; optical glass manufacturers; fertilizer plants; aircraft, munitions and armament manufacturers; scrap metal recycling facilities; zirconium manufacturing; oil and gas production, refining and storage; electricity generation; cement and concrete product manufacturers; and geothermal energy production. If the proposed exemption limit for TENORM (5 pCi/g Radium-226 + Radium-228) is exceeded then some of these industries may require a State license and State licensee discharge limits to sanitary sewer systems would be applicable. However, the Commission and the Department believe that the allowable limits for discharge to a sanitary sewer system from

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TENORM industries should be those in Table 1 of the Appendix of Subchapter 11 for the reasons described in the Summary.

The Commission and the Department believe that treating drinking water for radium contamination has a distinct beneficial impact on the citizens of New Jersey by reducing internal exposure to radiation. Any negative consequences to the sanitary sewer system can be minimized by monitoring the discharges and the sewage sludge. Therefore, the Commission and the Department believe that water treatment facilities should be allowed to discharge up to the proposed limits of Table 2 of the Appendix of Subchapter 11, which are approximately ten times the proposed limits set forth in Table 1 of the Appendix of Subchapter 11. There may be several TENORM industries in the State that discharge to the sanitary sewer system. However, the Commission and the Department believe that the positive impact from these TENORM operations is less than the reductions in risk realized by the public when radium is removed from drinking water through treatment. Therefore, the Commission and the Department believe that compliance with the proposed standards set forth in Table 1 of the Appendix of Subchapter 11 will have a positive social impact.

Currently the Department knows of only one operating facility that would have been affected by the revision to limit discharges of licensed TENORM industries, other than water treatment plants, to ten percent of the values in Table 2 of the Appendix to Subchapter 11. This facility has recently changed its feed material to one that is void of radioactive materials. The Department believes that the long term consequences of allowing TENORM untreated discharges may impact the ability of the sanitary sewer system to beneficially use their sludge. The Commission and the Department believe that the societal benefit from the operation of these facilities do not outweigh the negative consequences of disposing TENORM through the sanitary sewage system.

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Revised Licensing Exemptions

Where the regulation currently states naturally occurring radioactive material (NORM) whose specific activity does not exceed that of natural potassium (10^{-9} curies per gram of potassium which is the same as 1000 pCi/g) are exempt, the proposed regulation states that NORM, occurring in natural abundance and which has not been technologically enhanced (whether intentionally or unintentionally) are exempt. Those persons who receive, own, possess, use, process, transfer or distribute TENORM, if the materials contain any combination of Radium-226 and Radium-228 at concentrations less than 5 picocuries per gram (185 becquerals/kilogram) (dry weight) above background and less than the quantities listed in N.J.A.C. 7:28-4.5(c), are likewise exempt. The 5 pCi/g was taken from the CRCPD's Suggested State Regulation for TENORM, Part N. The revision to the exemption limit for TENORM is necessary to correct the inconsistency between the remediation standards at N.J.A.C. 7:28-12 and the current exempt concentration of NORM (1000 pCi/g). The current unrestricted use remediation standards for Radium-226 and Radium-228 are 5 pCi/g (depending on the depth of contamination and ratios of Ra-226 to Radium-228) as set forth in N.J.A.C. 7:28-12.9, Table 1A. By making the current remediation standard consistent with the licensure requirement, the Commission and the Department hope to prevent the creation of future radiologically contaminated sites through the imposition of strict controls in the State license on distribution, effluent levels, disposal, and final closure of a site when operations have ceased. Accordingly, the proposed TENORM exemption limit is expected to have a positive social impact.

Other exemptions from licensing requirements under N.J.A.C. 7:28-4 in the proposal include radon gas expelled to the outside atmosphere from radon mitigation systems installed according to the provisions of N.J.A.C. 7:28-27, and sewage sludge (residuals) which may contain TENORM from the partitioning process of the normal operations of a sanitary sewer system. The Commission and the Department believe the exemption for residuals is justified because distribution and disposal of residuals is regulated under N.J.A.C. 7:14A-20, "Standards

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for the Use or Disposal of Residuals". Beneficial use, including land application of residuals containing TENORM is currently being studied by the Department and by the Interagency Steering Committee on Radiation Standards Sewage Sludge Subcommittee, of which the Department is a member. If the Department determines that residuals should not be exempt and that rulemaking is necessary, it will be done under the Pretreatment and Residuals regulations. The distribution, including custom blending, possession and use of fertilizers containing TENORM is also proposed to be exempt. The Commission and the Department believe that this exemption is justified because the phosphate portion of the fertilizer (which may contain elevated levels of radium), is blended with nitrogen and potassium portions, which do not contain radium. Applying the blended fertilizer to land further dilutes the amount of radium in the soil to less than the licensing exemption criterion. These proposed exemptions are not expected to have a positive or negative social impact.

The Commission and the Department are proposing to exempt from licensure residual concentrations of radioactive materials at sites cleaned up under the Industrial Site Recovery Act (N.J.S.A. 13:1K-6 et seq). Concentrations of radioactive materials, including TENORM, in soil at such sites may be greater than the exempt concentration (i.e. less than 5 picocuries per gram dry weight above background and less than the quantity listed in N.J.A.C. 7:28-4.5(c)). However, such residual concentration must be maintained under engineering and institutional controls in accordance with N.J.A.C. 7:28-12.11 and must meet the dose criteria stipulated by State regulations found at N.J.A.C. 7:28-12.8(a). This proposed exemption is not expected to have a positive or negative social impact.

Increase in Staffing (Fees)

There will be a positive social impact from the proposed revisions to the fees in that an adequate program will be established to control radioactive materials in New Jersey. The public will benefit from the increase in staffing that will result. The additional personnel will enhance

the Department's ability to protect workers and the public from exposure to harmful radiation and will reduce the risks posed by the improper possession, use, or handling or radioactive materials. There are currently 440 State radioactive material licensees that will be affected by the fee increase. These State licensees are mainly hospitals, research facilities, pharmaceutical companies, universities, individual doctor offices, and some small businesses that operate lead paint analyzers.

Since the terrorist attack of September 11, 2001, the Department has spent a considerable amount of time preparing for a terrorist attack involving radioactive materials. The domestic security workload continues to increase, with no reason to expect a decline. More and more, staff have to respond to incidents involving radioactive materials. For example, in the past months, the following incidents have occurred:

? A residence was discovered in Essex County where radioactive materials and firearms were stockpiled, along with a bomb-making manual;

? The presence of a nuclear medicine patient on a tour bus leaving New York City caused the bus to bus set off radiation alarms in the Lincoln Tunnel;

? Highly radioactive material, suitable for use in a dirty bomb, was detected at a pipe foundry;

? Highly radioactive material, suitable for use in a dirty bomb, was detected at a metal recycling facility.

Additional Proposed Amendments

The proposed amendments that were added or revised to be compatible with the NRC regulations will have a positive social impact because they result in consistency between State regulations and NRC regulations and because they generally lower allowable effluent concentrations, exempt quantities, and discharges to the sanitary sewer. There are currently 440 State licensees, the majority of which (about seventy percent) are also NRC licensees. The Department and the Commission expect that these State licensees will react favorably to these changes because there would be more compatibility between the State and NRC regulations. The

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positive consequence is that the State's air and water supply will be improved since many of these proposed limits are reduced from the current limits.

Additional positive social impact will occur through the inclusion of facilities that manufacture, distribute, arrange for the distribution, sell or lease NARM, but are not currently included in the regulatory framework. Their inclusion will help ensure that radioactive materials are being used in a safe manner, thereby providing additional safeguards against unnecessary radiation exposure to members of the general public. The Department estimates that there are less than ten such facilities. One such facility has expressed concerns to the Department because it currently markets products containing radioactive material under its name and directs customer questions to its facility. However, the product is manufactured by a different facility. This separate facility has a license to manufacture products containing radioactive material. The Commission and the Department believe that the firms that are responsible for the distribution of the product and that deal directly with the customers, should be licensed under N.J.A.C. 7:28-4.1, in order for such firms to be accountable in case of an accident or bankruptcy of the manufacturer.

Economic Impact

Reduction of Public Dose

The Department and the Commission are proposing changes to the public radiation exposure limits in N.J.A.C. 7:28-6 to be consistent with NRC regulations. Since many New Jersey radioactive material licensees and registrants also possess NRC licensed radioactive materials and must comply with NRC regulations, the Commission and the Department do not believe that the proposed revisions at N.J.A.C. 7:28-6 will place an undue economic burden on the New Jersey radioactive materials licensees and radioactive materials registrants because most of them are already implementing these requirements.

Currently there are 22,893 radiation-producing machines in 8532 facilities registered in the State. Through a Department-conducted survey it was determined that seventeen medical therapeutic machines would have difficulty meeting the proposed 100 mrem/y public dose standard. These units operate at very high energies and the shielding at many of these facilities was designed to comply with a 500 mrem/year limit, the current State public dose standard.

If the new public dose standard is adopted as proposed, the Department would require that new radiation safety surveys be performed at facilities where non-compliance with the new standard appeared likely. Facilities that, even after adjustment for workload and occupancy, cannot comply with the new standards would need to modify shielding, change use or occupancy of adjacent space to prevent exposure. The cost of such modifications is difficult to determine because it is so site specific. A reasonable estimate of the range of costs is $200 for installation of a simple lead shield to thousands of dollars for a steel reinforced concrete barrier. If no other options are feasible, the facility may apply to the Commission on Radiation Protection for the Department to authorize the facility to conduct operations so that an individual member of the public receives no more than 500 mrem in one year (N.J.A.C. 7:28-6.2(d)). The applicant must demonstrate the need for such a limit, describe the program to assess and control dose within the 500 mrem annual limit, and describe the procedures that will be followed to maintain dose as low as reasonably achievable.

Revised Discharge Limits

There may be additional costs to TENORM small businesses that will now require a license under the proposal if they discharge above the proposed limits for TENORM. The Department is aware of only one mineral extraction business that would have been affected by the proposed TENORM discharge limits, but they have since changed their feed material which

is now void of radioactive materials. The reporting and record keeping requirements will involve the analysis of wastewater that is being discharged to a sanitary sewer system and the analysis of solid waste that is being produced. The business will require the services of a laboratory certified by the State for radiological analysis of water and solids and possibly a health physics consultant. The initial capital costs for such services could range from $10,000.00 to $20,000.00. An estimate of the annual compliance costs would range from $5,000.00 to $10,000.00. This reflects a reduced sampling frequency, once a characterization of the process has been performed.

Revised Licensing Exemptions

Responsible parties conducting activities under the Department's Site Remediation program, that treat contaminated ground water before discharge into sanitary sewers, may be required to obtain a license, if the amount of radioactive material that is stored in the treatment media before disposal exceeds the generally licensed quantities in N.J.A.C. 7:28-4.5(c). The Department does not believe this proposed revision would impose undue hardship on the parties that would be impacted. The cost of a license would be based on the specific non-human use category indicated by the facility in its license application. This cost would be either $2,500.00 or $3,300.00, depending on the quantity of material that is stored on site before disposal. In light of the cost of typical remediations, usually in the millions of dollars, the Commission and the Department believe this fee is minor.

Some cement processors and mineral processing facilities in New Jersey that technologically enhance naturally occurring radioactive materials will be required to obtain a radioactive materials license if the TENORM that they possess exceeds 5 pCi/g Radium-226 and Radium-228 combined and these facilities are not otherwise exempt from licensure. The Department and the Commission believe that these companies should be licensed by the Department in order to ensure radiation protection to the public and to provide accountability at

termination of their operation. In the past, industries that processed TENORM, who were not required to obtain a license, left hundreds of thousands of cubic yards of contaminated soil that now must be remediated under the soil cleanup regulation, N.J.A.C. 7:28-12. The cost to a facility for a license would depend upon the types and quantities of material in question. The annual license fee would be either $2,500.00 to $3,300.00, depending on the quantity in possession.

Increase in Staffing (Fees)

The Department is proposing to raise the fees charged to State licensees and radioactive materials registrants. Under the proposed revisions to the Department's fee schedule, the cost of a license would range from $350.00 to $2,000.00 for human use categories. The exact amount would depend upon which human use category is indicated by the facility and whether they possess material or administer material. The fee for possession of radioactive materials for human use activities is less than the fee for administration of radioactive material. The revised fees for non-human use categories would range from $200.00 to $4,950.00. The exact cost of a license in these categories would depend upon the form of the radioactive material (i.e. whether or not the material is in the form of a sealed source), the amount of material the licensee wishes to possess, the identity of the material (e.g. Co-57, Ra-226, etc.) and how the material is to be used. There will continue to be no charge for amendments to a license.

The Department is proposing to raise the fees in order to have the resources to implement a fully-staffed radioactive materials program. N.J.S.A. 26:2D-9(1) authorizes the Department to establish and charge fees for the services it performs. The calculation of fees may be based on the actual or projected expense to be incurred by the Department in the performance of services. The proposed fee increase is based on a cost analysis that takes into account the number and types of licensees and the amount of staff time and resources necessary to oversee these licensees and to engage in emergency preparedness activities. Staff time estimates were obtained from the

Conference of Radiation Control Program Directors (CRCPD's) publication #82-2, *Criteria for Adequate Radiation Control Programs (Radioactive Materials)*. The CRCPD is a professional organization whose primary membership is made up of radiation professionals in state and local government who regulate the use of radiation sources. Other members include individuals with an interest in radiation protection. CRCPD's mission is to promote consistency in addressing and resolving radiation protection issues, to encourage high standards of quality in radiation protection programs, and to provide leadership in radiation safety and education. Based on the CRCPD publication and an analysis of the Department's staffing needs in its radioactive materials program, the Department is proposing to increase the current fees by approximately 60 percent. The Department has not raised its fees for a radioactive materials license in twelve years, while the costs incurred by the Department, as set forth below, to process applications and issue licenses, conduct inspections, and establish an adequate program to address emergency response activities, including terrorism, have increased.

The current staffing level of the radioactive materials section makes it difficult to meet its statutory commitments. Having trained personnel available to respond to emergencies involving radioactive materials will have a beneficial economic effect on the public by being able to assess and communicate real property damages versus the ability to remediate and recover buildings, materials, and equipment. The ability to communicate radiation risks to the public will help the public to understand the reality of the threat so that any actions taken by the public are commensurate with the level of risk.

The annual costs to implement the radioactive materials program as currently staffed are as follows:

Current Radioactive Materials Section Licensing Staff and Operating Expenses

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Radiation Physicist I $73,832

Technician, MIS.....$37,010

Research Scientist 3.....$64,185

Environmental Specialist.....$35,439

Subtotal.....$210,466

Fringe - 24.15%.....$50,827

Indirect - 26.19%.....$68,433

Salary Total.....$329,726

Operating.....$120,000

Total.....$449,726

To determine the number of full time equivalent (FTE) positions required for a fully staffed Radioactive Materials program, the Department used the CRCPD's publication #82-2, *Criteria for Adequate Radiation Control Programs (Radioactive Materials*). Current New Jersey specific values are used in the Table.

Work Actions	Priority*	Number of Licensees	Required Actions/yr	Work Days per Action	Total Work Days/yr
Inspection Actions					
Broad Scope	I	4	2.7	7.1	19.17
Specific	I	106	70.7	2.5	176.75

	II	200	100	2.5	250
	III	130	43.3	2.5	108.25
Follow up		440	150	1	150
Licensing Actions		440	367	0.6	220
Subtotal					924.2
Other Duties (25% of Subtotal)					231
Administrative Actions (25% of Subtotal					231
Total					1386.2

Facility Inspection Cycle: *Priority I-every 18 months, Priority II-every 24 months, Priority III-every 36 months

The total work days per year (1386.2) are then divided by 225 work days (the amount of days actually worked taking into account sick time and vacation time), to determine the number of FTE positions required. This number is calculated to be 6.2 FTE. The above CRCPD analysis does not take into account the added responsibilities of emergency response since the events of September 11, 2001. The Commission and the Department believe that an additional FTE is necessary to prepare and respond to emergency situations involving radioactive materials. Therefore, since the Department's Radioactive Materials Section currently employs 4 FTE, the Department has determined that it needs an additional 3 FTE to run a fully staffed program. The Department believes that the additional staff costs and the increase in program costs justify the proposed fee increase.

Proposed Radioactive Material Section Licensing Staff and Operating Expenses

Research Scientist I $78,000

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Technician, MIS.....$40,000

Research Scientist 3.....$66,000

Environmental Specialist.....$41,000

Radiation Physicist 3.....$50,000

Radiation Physicist 3.....$50,000

Radiation Physicist 3.....$50,000

Subtotal.....$375,000

Fringe - 24.15%.....$90,562

Indirect - 26.19%.....$121,931

Salary Total.....$587,493

Operating.....$135,000

Total.....$722,493

The proposed total amount of required funding increases from $449,726.00 to $722,493.00, a 60 percent increase. A sixty percent increase in fees is being proposed to cover the costs of a fully staffed Radioactive Materials Section, including an increase of three FTE. The increase in salaries from the current staffing level accounts for anticipated cost of living and salary increment increases. The Radiation Physicist I title was changed to a Research Scientist I due to a promotion action that is in progress. The additional titles, 3 Radiation Physicists, will perform inspections, review applications and amendment requests, respond to State licensee inquiries, process reciprocity applications, calibrate instrumentation and inventory radioactive material sources. All members of the Radioactive Materials Section are members of the Radioactive Materials Radiological Assessment Team who respond to radioactive materials incidents and accidents. One of the Radiation Physicist 3's will be responsible for writing a

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manual and Standard Operating Procedures for emergency preparedness and responding to routine investigations such as alarm triggers at recycling and trash disposal facilities.

Additional Proposed Amendments

One of the proposed revisions will require those persons who manufacture, distribute or arrange for the distribution, arrange for their name to be on a product, sell or lease any naturally occurring or accelerator produced radioactive material (NARM) in New Jersey to be licensed by the State. The Department and the Commission always intended for companies that arrange for their name to be on a product to obtain a license, however, this licensing requirement is not explicitly stated in the current regulations. The cost to these companies, which the Department estimates to be less than ten, will depend upon the types and quantities of radioactive materials in question. The Department and the Commission estimate the annual license fees to be between $200.00 to $4,950.00 depending on the quantity, type and use of the radioactive material. These proposed fees were determined based on the analysis of the fee increase explained above.

Environmental Impact

The proposed amendments will have a positive effect on the environment, in that they reduce the amount of radiation allowed in the environment. Human exposure to radiation causes cancer. Any reduction of radiation allowed in the environment will have a positive effect on the health of humans. A fundamental tenet of radiation protection has been the assertion that populations of non-human biota are protected in situations where exposure levels are protective of humans (National Council on Radiation Protection Report No. 109, 1991), and so the Commission and the Department do not anticipate that plant, animal and marine life will be affected significantly by the proposed amendments.

Federal Standards Statement

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Executive Order No. 27(1994) and N.J.S.A. 52:14B-1 et seq. require State agencies which adopt, readopt or amend State regulations that exceed any Federal standards or requirements to include in the rulemaking document a Federal Standards Analysis. The proposed revisions do not exceed Federal standards. The comparable Federal rules are the U.S. Nuclear Regulatory Commission's (NRC) 10 CFR Part 20, "Standards for Protection Against Radiation", 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material" for general radiation protection requirements, and 10 CFR Part 35 "Medical Use of Byproduct Material". The proposed regulations as described above are the same as or compatible with NRC regulations, which is a necessary prerequisite should the Department choose to become an Agreement State.

The proposed revisions also address NARM, including TENORM, which are not regulated by the federal government. Accordingly, Executive Order No. 27 (1994) and N.J.S.A. 52:14B-1 et seq. do not require further analysis.

Jobs Impact

The proposed revisions are not expected to have any significant impact on employment or jobs, primarily because most of the licensed facilities in New Jersey are already complying with the majority of the proposed amendments. The proposed revisions can either be performed by an individual on site at the firms in question, or through the use of consultants in the radiation field. There may be a slight increase in clients for consultants in the radiation field due to the increase in firms that will need to obtain and maintain a radioactive materials license. The Department does not consider the increase in fees to be significant enough to cause firms to relocate to another state or to deter firms from moving to the State.

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Agricultural Impact Statement

Pursuant to N.J.S.A. 52:14B-4(a)2, the Commission and the Department have evaluated the proposed new rule and amendments to determine the nature and extent of its impact on the agricultural industry.

The Commission and the Department expect the proposed rule to have a positive impact on the State's agricultural industry. One of the primary environmental benefits expected to result from the proposed rule will be a reduction in loading of naturally occurring radioactive materials, including TENORM, into sanitary sewer systems. Under certain regional conditions, a build-up of radium, thorium, and uranium can occur in the sludge and ash of sanitary sewer systems. It is possible that if this sludge and/or ash is applied to farm fields, an increase in radionuclides above unrestricted use standards could occur after many years of land application. The proposed rule limits discharges of TENORM of some State licensees to the allowable effluent concentrations to water (Table 1 of the Appendix to Subchapter 11).

By limiting the amount of radioactive materials discharged to a sanitary sewer system, the Commission and the Department hope to reduce the likelihood of future contamination of sites above the unrestricted use standards in N.J.A.C. 7:28-12.9. This will have a positive impact on the sale of agricultural land that has land applied residuals because it will reduce the likelihood that the land would need to be subject to deed or other restrictions regarding radioactive materials.

Regulatory Flexibility Statement

As has been discussed, the majority of these proposed revisions are already required by the NRC, and NRC licensees are already complying with them. Since many New Jersey

radioactive materials licensees are also NRC licensees, most of the State licensees are already in compliance with the proposed regulations. The Commission and the Department estimate that approximately sixty-three percent of State radioactive materials licensees employ less than 100 persons and, therefore are defined as a "small business" under the New Jersey Regulatory Flexibility Act, N.J.S.A. 52:14B-16 et seq. The Commission and the Department do not believe that the proposed revisions will cause any increased cost to State licensees, other than the increase in licensing fees, since many of these State licensees are complying with the standards and limits set forth in the proposed amendments. The small businesses that would require a license under the proposal may include the mineral extraction and electronics industries. However, the Department has evaluated the impact of the fees and has determined that to minimize the impact to small businesses would endanger the public health and safety.

In order to reduce the record keeping burden to some very small businesses (licensees with lead paint analyzers), the Department has instituted an inspection-by-mail program. Since many of these businesses have only one employee, taking the time to be present during an inspection reduces the amount of time the employee is available to generate income. The Department has been implementing this program for four years and has received positive feedback from the licensees without decreasing vigilance in oversight of these licensed activities.

As discussed in the Economic Impact Statement above, TENORM industries that discharge to a sanitary sewer system may incur additional costs. However, the Commission and the Department have determined that to exempt these small businesses from the proposed requirements applicable to TENORM discharges, would have an adverse public health affect.

The proposed amendments do not minimize adverse economic impact to small businesses because of the potential impact to public health and safety. The measures being taken by the Department in regards to discharges to sanitary sewers help ensure that the risk to the public will not exceed a lifetime cancer incidence rate of three in ten thousand above background, which is

the US Environmental Protection Agency's acceptable upper risk range for cleanup of Superfund sites. This is not to imply that the current practices of any business in the State exceeds this risk, but the Commission and the Department believe that the proposed amendments will ensure that future impacts from the operation of these industries are minimized. The Department is willing to work together with businesses on specific licensing conditions so that undue record keeping and reporting is minimized for a small business.

Smart Growth Impact Statement

Executive Order No. 4 (2002) requires State agencies which adopt, amend or repeal any rule adopted pursuant to Section 4 (a) of the Administrative Procedure Act, to describe the impact of the proposed rule on the achievement of smart growth and implementation of the New Jersey Development and Redevelopment Plan (State Plan). The Department has evaluated this rulemaking to determine the nature and extent of the proposed amendments' impact on smart growth and the implementation of the State Plan. The proposed amendments do not involve land use policies or infrastructure development and therefore, do not impact the achievement of smart growth.

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Full text of the proposal follows (additions indicated by underline thus; deletions indicated in brackets [thus]):

SUBCHAPTER 1. GENERAL PROVISIONS

7:28-1.4 Definitions

(a) General terms:

•••

"Calendar quarter" means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be so arranged that no day in any year is omitted from inclusion within a calendar quarter. For purposes of this chapter, no State licensee, licensee, radioactive materials registrant or registrant shall change the method observed by him of determining calendar quarters except at the beginning of a calendar year.

•••

"Occupational dose" means [exposure of] the dose received by an individual [to radiation in a controlled area or] in the course of employment in which the individual's assigned duties involve exposure to radiation [, provided that "occupational dose" shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual.] from a machine source or to radioactive material from State licensed and unlicensed sources of radiation, whether in the possession of the State licensee, licensee or other person. Occupational dose does not include dose received from background radiation, from any medical administration the individual has received, from exposure to

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individuals administered radioactive material and released in accordance with federal regulations found in Title 10 Code of Federal Regulations, Part 35, section 75, or as a member of the public.

•••

"State licensee" means a person who is required to obtain a license from the Department pursuant to this chapter.

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(b) Ionizing radiation terms:

"Adult" means an individual 18 or more years of age.

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"Collective dose" means the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

"Committed dose equivalent" ($H_{T,50}$) means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50 year period following the intake.

"Committed effective dose equivalent" ($H_{E,50}$) means the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50} = \sum w_T H_{T,50}$).

•••

"Declared pregnant woman" means a woman who has voluntarily informed the State licensee, radioactive materials registrant or registrant, in writing, of her pregnancy and the

estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing, or is no longer pregnant.

"Deep-dose equivalent" (H_d), which applies to external whole-body exposure, means the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

•••

"Dose or radiation dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined in other paragraphs of this section.

"Effective dose equivalent" (H_E) means the sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (w_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \sum w_T H_T$).

•••

"Licensee" means a person who is required to obtain a license from the U.S. Nuclear Regulatory Commission or any state other than New Jersey.

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"Member of the public" means any individual except when that individual is receiving an occupational dose.

"Minor" means an individual less than 18 years of age.

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"NARM" means any naturally occurring or accelerator produced radioactive material.

"NORM" means any naturally occurring radioactive material.

•••

"Public dose" means the dose received by a member of the public from exposure to radiation from a machine source or to radioactive material released by a State licensee, or to any other source of radiation under the control of a licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the patient has received, or from exposure to individuals administered radioactive material and released in accordance with federal regulations found in 10 CFR 35, section 75.

•••

"Radioactive materials registrant" means a person who is required to register radioactive by-product material, source material or special nuclear material with the Department pursuant to this chapter.

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"Reference man" means a hypothetical aggregation of human physical and physiological characteristics arrived at by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base.

"Registrant" means a person who is required to register a machine source of radiation with the Department pursuant to this chapter.

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"Residual" means a solid waste that consists of the accumulated solids and associated liquids which are by-products of a physical, chemical, biological, or mechanical process or any other process designed to treat wastewater or any other discharges subject to regulation under the New Jersey Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., as amended. For purposes of this chapter, residual includes, but is not limited to, marketable residual product, sludge and sewage sludge. Residual excludes screened vegetative waste and grit and screenings. The terms used in this definition shall have the same meaning as those in N.J.A.C. 7:14A-1.2.

•••

"Sanitary sewer system" means any device or system used in the storage and treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature which is owned by a State or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a sanitary sewer system providing treatment. A synonym for sanitary sewer system is publicly owned treatment works (POTW).

•••

"Stochastic effects" means health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

•••

"Technologically enhanced naturally occurring radioactive materials" or "TENORM" means any naturally occurring radioactive materials whose radionuclide concentrations or potential for human exposure have been increased by any human activities.

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"Total effective dose equivalent" (TEDE) means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

•••

"Unrestricted area" means an area, access to which is neither limited nor controlled by the State licensee or registrant.

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"Very high radiation area" means an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates. Note that at very high doses received at high dose rates, units of absorbed dose (e.g. rads and grays) are appropriate, rather than units of dose equivalent (e.g. rems and sieverts).

"Water treatment facility" means an entity that applies a treatment device to drinking water for the purpose of reducing contaminants. The entity may be a community water system or non-community water system as defined by the EPA in 40 CFR 141.

"Weighting factor" (w_T) for an organ or tissue (T) means the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of w_T are:

ORGAN DOSE WEIGHTING FACTORS

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Organ or Tissue	w_T
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	0.30[a]
Whole Body	1.00[b]

[a] 0.30 results from 0.06 for each of 5 "remainder" organs (excluding the skin and the lens of the eye) that receive the highest doses.

[b] For the purpose of weighting the external whole body dose (for adding it to the internal dose), a single weighting factor, $w_T = 1.0$, has been specified.

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SUBCHAPTER 2. USE OF SOURCES OF IONIZING RADIATION AND SPECIAL EXEMPTIONS

7:28-2.1 Authorized use of sources of ionizing radiation

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(a) No person shall manufacture, use, operate, receive, possess, dispose, transfer, distribute or arrange for the distribution, sell, lease, install, transport or store sources of ionizing radiation in a manner other than prescribed in this chapter.

(b) No person shall cause, suffer, allow or permit any person to manufacture, use, operate, receive, possess, dispose, transfer, distribute or arrange for the distribution, sell, lease, install, transport or store sources of ionizing radiation in a manner other than prescribed in this chapter.

7:28-2.2 Supervision

(a) (No change.)

(b) Any person applying to the Department for a State license, registration or certificate pursuant to this chapter, shall include in his application the name of at least one person who has satisfied the requirements of (a) above.

SUBCHAPTER 3. REGISTRATION OF IONIZING RADIATION-PRODUCING MACHINES AND RADIOACTIVE MATERIALS

7:28-3.5 Registration of radioactive by-product material, source material and special nuclear material

(a) (No change.)

(b) A radioactive materials registrant does not have to apply for a new or amended registration for receipt of each shipment of a type of radioactive material for which it has a valid current registration provided that the total amount of such type of radioactive material in the

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radioactive materials registrant's possession, custody or control does not exceed the amount authorized in its registration for such type of material.

(c)-(d) (No change.)

7:28-3.8 Amendments to registration of radioactive by-product material, source material or special nuclear material

A radioactive materials registrant shall notify the Department in writing within 30 days [of] after any change in the license issued by the Nuclear Regulatory Commission for possession, custody or control of any type of radioactive by-product material, source material or special nuclear material when there is a change in the type and/or quantity of such material or when there is a change in the designated licensed user(s) or radiation safety officer.

7:28-3.10 Denial of an application for registration, and suspension, modification, or revocation of registration of ionizing radiation-producing machines, radioactive by-product material, source material or special nuclear material

(a) The Department, in addition to any penalties authorized by the Act, may deny an application for registration or suspend, modify or revoke a registration of ionizing radiation-producing machines, radioactive by-product material, source material or special nuclear material by reason of amendments to the Act, adoption of rules, orders issued by the Department pursuant to said Act or if the applicant, radioactive materials registrant or registrant:

1.-7. (No change.)

(b) (No change.)

(c) The Department may terminate a registration upon request submitted by the radioactive materials registrant or registrant to the Department in writing.

7:28-3.13 Fees for registration of radioactive by-product material, source material and special nuclear material

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(a) Fees for initial registration, annual registration renewal and each registration amendment for possession, custody or control of radioactive by-product material, source material and special nuclear material as provided below shall be paid in full by the [applicant/] radioactive materials registrant.

1. Initial Registration Fee: [$150.00] $250.00;

2. Annual Registration Renewal: [$100.00] $165.00;

3. Each Amendment to Registration: [$100.00.] $165.00.

(b) - (c)(No change.)

(d) In the event that registration renewal fees are paid later than 30 days after August 1, a delinquency fee equal to one-half of the annual [license] registration fee will be imposed. Failure to pay a registration renewal fee, including any accrued delinquency fees for longer than 90 days after August 1 shall constitute grounds for suspension or revocation of the registration pursuant to N.J.A.C. 7:28-3.10.

(e) - (g)(No change.)

(h) Fees submitted to the Department are non-refundable.

SUBCHAPTER 4. LICENSING OF NATURALLY OCCURRING [AND] OR ACCELERATOR PRODUCED RADIOACTIVE MATERIALS

7:28-4.1 [License required for the production, transfer, receipt, acquisition, ownership, possession or use of all naturally occurring and accelerator produced radioactive materials.] Scope and general provisions

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(a) This subchapter shall apply to persons who manufacture, produce, transfer, distribute or arrange for the distribution, sell, lease, receive, acquire, own, possess or use any naturally occurring or accelerator produced radioactive materials, including TENORM, in this State.

(b) No person shall manufacture, produce, transfer, distribute or arrange for the distribution, sell, lease, receive, acquire, own, possess or use [any radioactive substance obtained from naturally occurring materials or produced by an accelerator] any naturally occurring or accelerator produced radioactive materials, including TENORM, in this State unless authorized by a specific State license issued by the Department as provided by N.J.A.C. 7:28-4.7 and 4.8, a general State license as provided in N.J.A.C. 7:28-4.5, or an exemption as provided in N.J.A.C. 7:28-4.3. Excepted from this provision are byproduct, source [materials] and special nuclear materials.

(c) A person who sells, transfers, distributes or arranges for the distribution of a device containing naturally occurring or accelerator produced radioactive materials manufactured by another person, but which is sold, transferred or distributed under its own name, shall obtain a State license in accordance with this subchapter.

7:28-4.2 Recognition of licenses from other jurisdictions

(a) (No change.)

(b) The Department may withdraw, limit or qualify its acceptance of such licenses issued by another agency, or any produc[e]t distributed pursuant to such licensing documents, upon determining that such action is necessary in order to prevent undue hazard to public health and safety or property.

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7:28-4.3 Exemption from requirement for a State license for manufacture, production, transfer, distribution or arrangement of distribution, sale, lease, receipt, acquisition, ownership, possession or use of all naturally occurring [and] or accelerator produced radioactive materials

(a) A person shall be exempt from the requirement to obtain a State license [for the production, transfer, receipt, acquisition, ownership, possession or use of all naturally occurring and accelerator produced radioactive materials as follows] for the following activities:

1. - 2. (No change.)

3. [To the extent that such] The person manufactures, produces, receives, possesses, uses, transfers, distributes or arranges for the distribution, sells, leases, owns or acquires products or materials containing naturally occurring or accelerator produced radioactive materials [substances] in concentrations not in excess of those exempted in N.J.A.C. 7:28-4.3(b);

4. [To the extent that such] The person manufactures, receives, possesses, uses, transfers, distributes or arranges for the distribution, sells, leases, owns or acquires luminous timepieces or parts thereof containing radium. However, any person who desires to apply radium to luminous timepieces or parts thereof is not exempt and must obtain a specific State license;

5. [N] The person owns or possesses naturally occurring radioactive materials [of an equivalent specific radioactivity not exceeding that of natural potassium (10^{-9} curies per gram of potassium)], occurring in natural abundance and which are not technologically enhanced naturally occurring radioactive materials, whether intentionally or unintentionally;

6. [If the Department, upon request by an owner or on its own initiative with the approval of the Commission, grants a specific exemption from any requirements of this subchapter should it determine that such exemption is not likely to result in unnecessary radiation.] The person who receives, owns, possesses, uses, processes, transfers, distributes, arranges for the distribution, sells or leases technologically enhanced naturally occurring radioactive materials (TENORM) if the TENORM contain any combination of Radium-226 and

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Radium-228 at concentrations less than 5 pCi/g (185 Bq/kg) (dry weight) above background and less than the quantity listed in (c) below;

7. The person owns property where radon gas is being expelled to the outside atmosphere as part of a radon remediation system installed in accordance with the provisions of N.J.A.C. 7:28-27;

8. The person owns a sanitary sewer system where residuals are present which may contain TENORM from the separation of liquids and solids which is the outcome of normal operations of the sanitary sewer system.

9. The person is involved with the distribution, including custom blending, possession, and use of fertilizers containing TENORM; and

10. The person owns property where residual contamination remaining at the site was remediated under the jurisdiction of the Industrial Site Recovery Act (N.J.S.A. 13:1K-6 et seq.). Such residual concentrations may be greater than the limits specified in (a)6 above, but be under restricted conditions imposed by the Department (such as engineering and institutional controls), and meet the dose criteria specified in N.J.A.C. 7:28-12.8(a).

(b) The following concentrations of [radioactive substances] NARM, including TENORM, when obtained from naturally occurring materials or when produced by an accelerator are exempt from the requirements for a State license [for the production, transfer, receipt, acquisition, ownership or use of all naturally occurring and accelerator produced radioactive materials]:

[

Element (Atomic Number)	Isotope	Gas Concentrations uCi/cc*	Liquid & Solid Concentrations uCi/cc**
Beryllium (4)	Be 7	--	2×10^{-2}
Cadmium (48)	Cd 109	--	2×10^{-3}
Carbon (6)	C 14	1×10^{-6}	8×10^{-3}
Chromium (24)	Cr 51	--	2×10^{-2}
Cobalt (27)	Co 57	--	5×10^{-3}
Hydrogen (1)	H 3	5×10^{-6}	3×10^{-2}
Iron (26)	Fe 55	--	8×10^{-3}
Manganese (25)	Mn 52	--	3×10^{-4}

Manganese (25)	Mn 54	--	1×10^{-3}
Tungsten (74)	W 181	--	4×10^{-3}
Vanadium (23)	V 48	--	3×10^{-4}
Zinc (30)	Zn 65	--	1×10^{-3}
Beta and/or gamma emitting radioactive material not listed above with half life less than 3 years	--	1×10^{-10}	1×10^{-6}

*Values are given only for those materials normally used as gases.

** uCi/gm for solid]

OAL, the following is a new table to appear in boldface.

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Exempt Concentrations

Element (nuclide)	Column 1	Column 2
	Gas concentration (uCi/ml)	Liq. & solid concentration (uCi/ml)
Argon (Ar-37)	1×10^{-3}	------
Arsenic (As-73)	------	5×10^{-3}
(As-74)	------	5×10^{-4}
Barium (Ba-131)	------	2×10^{-3}
Beryllium (Be-7)	------	2×10^{-2}
Bismuth (Bi-206)	------	4×10^{-4}
(Bi-207)*	------	2×10^{-4}
Cadmium (Cd-109)	------	2×10^{-3}
Chromium (Cr-51)	------	2×10^{-2}
Cobalt (Co-56)*	------	1.2×10^{-4}
(Co-57)	------	5×10^{-3}
(Co-58)	------	1×10^{-3}
Dysprosium (Dy-159)*	------	4×10^{-3}
Fluorine (F-18)	2×10^{-6}	8×10^{-3}
Gallium (Ga-67)*	------	2×10^{-3}
Germanium (Ge-68)*	------	1.2×10^{-3}
(Ge-71)	------	2×10^{-2}
Gold (Au-196)	------	2×10^{-3}
Au-199)	------	2×10^{-3}
Indium (In-111)*	------	1.2×10^{-3}
(In-113m)	------	1×10^{-2}
Iodine (I-123)*	4×10^{-7}	2×10^{-3}
(I-124)*	8×10^{-9}	4×10^{-5}
Iridium (Ir-190)	------	2×10^{-3}
(Ir-192)	------	4×10^{-4}
Iron (Fe-55)	------	8×10^{-3}
Krypton (Kr-85m)	1×10^{-6}	------
Lead (Pb-201)*	------	2×10^{-3}
(Pb-203)	------	4×10^{-3}
(Pb-210)*	------	2×10^{-7}
Manganese (Mn-52)	------	3×10^{-4}
(Mn-54)	------	1×10^{-3}
Mercury (Hg-197m)	------	2×10^{-3}
(Hg-197)	------	3×10^{-3}
Neptunium (Np-237)*	------	4×10^{-7}
Palladium (Pd-103)	------	3×10^{-3}
Platinum (Pt-191)	------	1×10^{-3}
(Pt-193m)	------	1×10^{-2}
(Pt-197m)	------	1×10^{-2}

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Element (nuclide)	Column 1	Column 2
	Gas concentration (uCi/ml)	Liq. & solid concentration (uCi/ml)
Radium (Ra-226)*	------	1.2×10^{-6}
(Ra-228)	------	4×10^{-11}
Rhenium (Re-183)	------	6×10^{-3}
Rubidium (Rb-81)*	------	1×10^{-2}
(Rb-83)*	------	1.8×10^{-4}
(Rb-84)*	------	1.4×10^{-4}
Ruthenium (Ru-97)	------	4×10^{-4}
Samarium (Sm-153)	------	8×10^{-4}
Scandium (Sc-48)	------	3×10^{-4}
Silver (Ag-105)	------	1×10^{-3}
(Ag-111)	------	4×10^{-4}
Sodium (Na-22)*	------	1.2×10^{-4}
Tantalum (Ta-179)*	------	6×10^{-3}
Technetium (Tc-96)	------	1×10^{-3}
Thallium (Tl-200)	------	4×10^{-3}
(Tl-201)	------	3×10^{-3}
(Tl-202)	------	1×10^{-3}
**Thorium (Th-228)*	------	4×10^{-6}
(Th-230)*	------	2×10^{-6}
(Th-232)*	------	6×10^{-7}
(Th-234)*	------	1×10^{-4}
Thulium (Tm-170)	------	5×10^{-4}
Tungsten (Wolfram) (W-181)	------	4×10^{-3}
**Uranium (U-234)*	------	6×10^{-6}
(U-235)*	------	6×10^{-6}
(U-238)*	------	6×10^{-6}
Vanadium (V-48)	------	3×10^{-4}
Yttrium (Y-88)*	------	2×10^{-4}
(Y-92)	------	6×10^{-4}
Zinc (Zn-69m)	------	7×10^{-4}
Any other beta/gamma emitter with half-life < 3 years	1×10^{-10}	1×10^{-6}

*The values for those NARM nuclides, including TENORM, that are followed by a single asterisk(*) are based upon multiplying 20 times the most restrictive release concentrations specified in 10 CFR 20 Appendix B, Table 2, Columns 1 (air) and 2 (water).

**These concentrations do not apply to source material as defined by the NRC for thorium and uranium .

1. Many radioisotopes disintegrate into isotopes which are also radioactive. In expressing the concentrations in this section, the value given is that of the parent isotope and takes into account the radioactivity of the daughters.

2. For purposes of N.J.A.C. 7:28-4.3(a)[4]3, where a combination of isotopes is involved, the limit for the combination shall be computed as follows:

i. Determine for each isotope in the product the ratio between the concentration present in the product and the exempt concentration established in this section for the specific isotope when not in combination. The sum of such ratios may not exceed ``1" (unity).

[Example:

Prod. Conc.		Prod. Conc.	Prod. Conc.	
of Isotope A		of Isotope B	of Isotope C	
	+		+	≤ 1
Exempt Conc.		Exempt Conc.	Exempt Conc.	
of Isotope A		of Isotope B	of Isotope C]	

Example:

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$$\frac{\text{Concentration of Isotope A in Product}}{\text{Exempt concentration of Isotope A}} + \frac{\text{Concentration of Isotope B in Product}}{\text{Exempt concentration of Isotope B}} < 1$$

(c) If a person manufactures, produces, transfers, distributes or arranges for the distribution, sells, leases, receives, acquires, owns, possesses or uses NARM, including TENORM, in quantities less than those listed in N.J.A.C. 7:28-4.5(c), they are exempt from the requirement for a license.

7:28-4.4 Types of licenses for manufacture, production, transfer, distribution or arrangement for distribution, sale, lease, receipt, acquisition, ownership, possession or use of all naturally occurring [and] or accelerator produced radioactive materials

(a)-(b) (No change.)

7:28-4.5 General licenses for the transfer, distribution or arrangement for distribution, sale, lease, receipt, acquisition, ownership, possession or use of naturally occurring [and] or accelerator produced radioactive materials and certain devices and equipment

(a) Any person who uses, transfers, distributes or arranges for the distribution, sells, leases, receives, acquires, owns or possesses the following devices and equipment incorporating naturally occurring [and/or] or accelerator produced radioactive material, when manufactured, tested and labeled by the manufacturer in accordance with the specifications contained in a specific license issued by the Department, or a specific license of a Federal agency or any other state, shall be deemed to have a general State license:

1.-3. (No change.)

(b)-(e) (No change.)

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(f) Persons who transfer, distribute or arrange for the distribution, sell, lease, receive, acquire, own, possess or use items and quantities of radioactive materials set forth in N.J.A.C. 7:28-4.5(a) and (c) pursuant to a general State license shall not:

1.-4. (No change.)

(g) (No change.)

7:28-4.6 Application for and renewal of specific State licenses for manufacture, transfer, distribution or arrangement for distribution, sale, lease, receipt, acquisition, ownership, possession or use of naturally occurring [and] or accelerator produced radioactive materials

(a)-(j) (No change.)

(k) All applications for a State license or amendment shall be signed by the applicant or State licensee or a person duly authorized to act for and on his behalf.

(l) (No change.)

7:28-4.7 General requirements for approval of an application for an initial specific State license or renewal of a specific State license for use of naturally occurring [and] or accelerator produced materials

(a)-(b) (No change.)

(c) To qualify for an initial specific State license or renewal of a specific State license for human use of radioactive materials for any purpose described in Groups I though VI in (b)[,] above, the applicant must demonstrate qualification by reason of training and experience to use the radioactive material for the purpose requested and in such manner as to protect health, minimize danger to life or property, and prevent unnecessary radiation, by satisfying the training and experience requirements for the appropriate Human Use Group of activities as follows:

1.-7. (No change.)

8. In addition to the training required by (c)7 above, an applicant for a specific State license for Human Use Group VI activities shall demonstrate that its proposed

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equipment, facilities and procedures are adequate to protect health, minimize danger to life or property and prevent unnecessary radiation; and

9. An applicant for a specific State license for Human Use Group VI activities shall satisfy special requirements as may be applicable in N.J.A.C. 7:28-4.8.

7:28-4.8 Special requirements for approval of an application for an initial specific State license or renewal of a specific State license for use of naturally occurring [and] or accelerator produced radioactive materials

(a) If the Department determines that an applicant meets the requirements of this subchapter and the Act, an initial specific State license or renewal of a specific State license may be issued for human use of radioactive materials by an institution provided:

1. (No change.)

2. The applicant has appointed a medical isotopes committee to evaluate all proposals for research, diagnosis, and therapeutic use of radioactive material within that institution. Membership of the committee shall include one authorized user for each type of use permitted by the specific State license, the radiation safety officer, a representative of the nursing service, and a representative of management who is neither an authorized user nor a radiation safety officer;

3.-5. (No change.)

(b)-(f) (No change.)

(g) If the Department determines that an applicant meets the requirements of this subchapter and the Act, an initial specific State license or renewal of a specific State license may be issued for use of a sealed source or sources of radioactive materials in industrial and nonmedical radiography provided:

1. (No change.)

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2. The applicant has an adequate program for training radiographers and radiographers' assistants and submits to the Department a schedule or description of such program which specifies the following:

i.-iii. (No change.)

iv. Means to be used by the specific State licensee to determine the radiographer's knowledge and understanding of and ability to comply with the requirements of this subchapter, the specific licensing requirements, and the operation and emergency instructions of the applicant; and

v. Means to be used by the specific State licensee to determine the radiographer's assistant's knowledge and understanding of and ability to comply with the operating and emergency procedures of the applicant;

3.-6. (No change.)

(h) If the Department determines that an applicant meets the requirements of this subchapter and the Act, an initial specific State license or renewal of a specific State license will be issued to transfer, possess, or control products or materials containing exempt concentrations of radioactive material specified in N.J.A.C. 7:28-4.3(b) which the transferor has introduced into the product or material provided:

1.-3. (No change.)

4. Within 30 days subsequent to the end of the reporting period, each specific State licensee shall file an annual report with the Department describing kinds and quantities of products transferred, the concentration of radioactive material contained and the quantity of radioactive material transferred during the reporting period which shall be the 12 month period ending June 30 of each calendar year.

(i) If the Department determines that an applicant meets the requirements of this subchapter and the Act, an initial specific State license or renewal of a specific State license may be issued to distribute certain devices to persons specifically licensed under N.J.A.C. 7:28-4.7 provided:

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1.-2. (No change.)

3. Each device distributed as authorized by such specific State license is to bear a label containing the following or substantially similar statements:

i.-iii. (No change.)

iv. The following statement:

"This device contains radioactive material and has been manufactured for distribution as a specifically State licensed device pursuant to

---

(identify appropriate section of the regulation)

(name of licensing agency and state)

License No._____by_____(name of supplier)

Disposal of this device shall conform to the requirements listed in N.J.A.C. 7:28-4.5(g)6ii of the Radiation Protection Code. Removal of this label is prohibited."

7:28-4.9 Terms and conditions of general and specific State licenses

(a) (No change.)

(b) No State license to possess or utilize radioactive material pursuant to this subchapter shall be transferred or assigned.

(c) Each person licensed by the Department pursuant to this subchapter shall confine his/her possession and use of radioactive material to the locations and purposes authorized by such State license, and shall not use or permit the use of radioactive materials contrary to the

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applicable requirements of this chapter. Persons licensed under the provisions of this subchapter may transfer radioactive material within the State only to the persons licensed to receive such material or as otherwise authorized by the Department in writing.

(d) The Department may incorporate in any State license at the time of issuance, or thereafter, all such additional requirements and conditions with respect to the State licensee's manufacture, distribution or arrangement for the distribution, sale, lease, receipt, possession, use, ownership or transfer of radioactive material as it deems appropriate or necessary in order to assure compliance with this chapter and the Act.

(e) Each State licensee authorized under N.J.A.C. 7:28-4.8(f) to distribute certain devices to generally licensed persons shall:

1.-2. (No change.)

(f) Each State licensee authorized under N.J.A.C. 7:28-4.8(i) to distribute certain devices to specifically licensed persons shall:

1. (No change.)

7:28-4.11 Status of specific State licenses pending renewal

In any case in which a specific State licensee has filed a complete application in proper form for renewal of a specific State license not less than 30 days prior to expiration of the existing specific State license, such specific State license and all its existing conditions shall not expire until the Department has acted upon the application.

7:28-4.12 Amendment of a specific State license at request of licensee

(a) (No change.)

(b) The Department will evaluate only amendment applications submitted by personnel authorized by the State licensee.

(c) (No change.)

7:28-4.14 Inspections

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(a) All State licensees shall allow the Department or its agents to inspect radioactive material and the facilities and premises where radioactive material is used or stored.

(b) (No change.)

(c) Upon request by the Department, or its agents, State licensees shall make available for inspection by the Department records kept pursuant to this chapter.

7:28-4.15 Tests

(a) At the request of the Department or its agents, each State licensee shall perform, or allow the Department to perform if the Department so desires, such tests as the Department deems appropriate or necessary for the administration of this subchapter, including tests of the following:

1.-4. (No change.)

7:28-4.16 Modification, revocation, suspension, and termination of general and specific State licenses

(a) Each general State license shall be subject to modification, suspension or revocation by reason of amendments to the Act, adoption of rules by the Commission or the Department, orders issued by the Department pursuant to authority of the Act, or for violation or failure to observe any of the terms and provisions of the Act, State license or any rule of the Commission or the Department, or order of the Department.

(b) Each specific State license shall be subject to modification, suspension or revocation by reason of:

1.-4. (No change.)

5. Violation of or failure to observe any of the terms and provisions of the Act or the State license, or any rule of the Commission of Department or order of the Department;

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6. Falsification or misleading statements in any State license application;

7. Alteration of State licensing document;

8. (No change.)

9. Failure to make timely payment of State licensing fees.

(c) If a specific State license is not to be renewed or if a State licensee requests a termination of its State license, the State licensee shall furnish to the Department, prior to the expiration date of the State license, close-out surveys, [and/or] wipe tests [of] and/or soil samples demonstrating that the facility meets the requirements of N.J.A.C. 7:28-12. [t]The facility shall also provide [and] a disposition certificate attesting to the disposal of radioactive material.

7:28-4.18 Requirements governing requests for stay of the effective date of the Department decision for which an adjudicatory hearing is requested

(a) The Department may grant a stay of the effective date of a decision to deny, modify, revoke or suspend any State license. The applicant for such a stay must submit evidence that one of the following circumstances exist:

1.-2. (No change.)

(b)-(f) (No change.)

7:28-4.19 Specific State license fee schedule for the manufacture, production, transfer, distribution or arrangement for distribution, sale, lease, receipt, acquisition, ownership, possession or use of naturally occurring or accelerator produced radioactive material

(a) The specific State license fee schedule [for the production, transfer, receipt, acquisition, ownership, possession or use of naturally occurring or accelerator produced radioactive materials] is as follows:

Category	Annual License Fee

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1.	Radioactive materials license for Human Use Group I:		
	i.	Possession of material only;	[$ 200.00]$350.00
	ii.	Administration of less than 10 doses per year;	[$ 300.00]$500.00
	iii.	Administration of 10 through 49 doses per year;	[$ 400.00]$650.00
	iv.	Administration of 50 or more doses per year.	[$ 500.00]$850.00
2.	Radioactive materials license for Human Use Group II:		
	i.	Possession of material only;	[$ 200.00]$350.00
	ii.	Administration of less than 200 doses per year;	[$ 400.00]$650.00
	iii.	Administration of between 200 and 1,499 doses per year:	[$ 800.00]$1,300.00
	iv.	Administration of 1,500 or more doses per year.	[$1,200.00]$2,000.00
3.	Radioactive materials license for Human Use Group III:		
	i.	Possession of material only;	[$ 200.00]$350.00
	ii.	Administration of less than 200 doses per year;	[$ 200.00]$350.00
	iii.	Administration of 200 through 999 doses per year;	[$ 400.00]$650.00
	iv.	Administration of 1,000 or more doses per	

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year. [$ 500.00]$850.00

4. Radioactive materials license for Human Use Group IV:

i. Possession of material only; [$ 200.00]$350.00

ii. Administration of less than 10 doses per year; [$ 300.00]$500.00

iii. Administration of 10 through 49 doses per year; [$ 400.00]$650.00

iv. Administration of 50 or more doses per year. [$ 500.00]$850.00

5. Radioactive materials license for Human Use Group V:

i. Possession of material only; [$ 200.00]$350.00

ii. Administration of less than 10 doses per year; [$ 300.00]$500.00

iii. Administration of 10 through 49 doses per year; [$ 400.00]$650.00

iv. Administration of 50 or more doses per year. [$ 500.00]$850.00

6. Radioactive materials license for Human Use Group VI:

i. Possession of material only; [$ 500.00]$850.00

ii. Administration of less than 10 doses per year; [$ 600.00]$1,000.00

iii. Administration of 10 through 49 doses per year; [$ 700.00]$1,150.00

iv. Administration of 50 or more doses per

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	year.	[$ 800.00]$1,300.00
7.	Radioactive material license for commercial manufacture, processing and/or distribution of radioactive materials for Human Use.	[$3,000.00]$4,950.00
8.	Radioactive materials license for commercial manufacture, processing and/or distribution of radioactive materials.	[$3,000.00]$4,950.00
9.	Radioactive materials license for radioactive materials as sealed sources used for calibration and quality control purposes with a possession limit of 10 mCi or less.	[$ 600.00]$1,000.00
10.	Radioactive materials license for radioactive materials, as sealed sources used for calibration and quality control purposes with a possession limit greater than 10 mCi.	[$1,000.00]$1,650.00
11.	Radioactive materials license for radioactive materials as sealed sources contained in devices used for analytical purposes with a possession limit of one mCi or less.	[$ 500.00]$850.00
12.	Radioactive materials license for radioactive materials, except radium 226, as sealed sources, contained in devices used for analytical purposes with a possession limit greater than one mCi but less than or equal to 300 mCi:	
	i. A government body, department, agency, authority, or any other unit of any state,	

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	Federal, county or local government using X-ray fluorescence devices for lead paint analysis	[$ 100.00]$200.00
	ii. All others	[$ 750.00]$1,250.00
13.	Radioactive materials license for radioactive materials, except radium-226, as sealed sources, contained in devices used for analytical purposes with a possession limit of greater than 300 mCi.	[$1,000.00]$1,650.00
14.	Radioactive materials license for radioactive radium-226, as sealed sources, contained in devices used for analytical purposes with possession limit greater than one mCi but less than or equal to 50 mCi.	[$1,000.00]$1,650.00
15.	Radioactive materials license for radioactive radium-226, as sealed sources, contained in devices used for analytical purposes with a possession limit greater than 50 mCi.	[$1,500.00]$2,500.00
16.	Radioactive materials license for radioactive materials as sealed sources for Non-Medical Industrial Radiography.	[$2,000.00]$3,300.00
17.	Radioactive materials license for radioactive materials not as sealed sources with a possession limit of 500 mCi or less.	[$1,500.00]$2,500.00
18.	Radioactive materials license for radioactive materials not as sealed sources with a possession limit of greater than 500 mCi.	[$2,000.00]$3,300.00

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(b) All State licensees shall pay the fees set forth in (a) above by check payable to "Treasurer, State of New Jersey" prior to August 1 of each year.

1. In the event that the fees are paid after August 1, a delinquency fee equal to one-half of the annual State license fee will be imposed. Failure to pay an annual State license fee including any accrued delinquency fees for longer than 90 days after August 1 shall constitute grounds for suspension or revocation of the State license pursuant to N.J.A.C. 7:28-4.16.

2. The annual State license fee shall be mailed to:

State of New Jersey
Department of Environmental Protection
Bureau of Revenue
PO Box 420
Trenton, New Jersey 08625-0420

(c) Facilities for which multiple State license categories apply shall be charged the sum of the fees for each of the applicable categories.

(d) - (e)(No change.)

(f) Fees submitted to the Department are non-refundable.

7:28-4.20-4.28 (No change.)

SUBCHAPTER 6. [PERMISSIBLE DOSE RATES, RADIATION LEVELS AND CONCENTRATIONS] DOSE LIMITS

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7:28-6.2 [Radiation levels outside controlled areas] Dose limits for individual members of the public

(a) Each State licensee or registrant shall conduct operations as follows-

1. The total effective dose equivalent to individual members of the public from the State licensed or registered operation does not exceed 0.1 rem (1 millisievert) in a year, exclusive of the dose contributions from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with federal regulations at 10 CFR 35.75, and from the State licensee's disposal of radioactive material into a sanitary sewer system in accordance with N.J.A.C. 7:28-11.2, and

2. [The radiation level at any point outside the confines of the controlled area shall be limited to a value such that there is no reasonable possibility that any individual outside the controlled area will receive a radiation dose to the whole body, head and trunk, active blood- forming organs, gonads, or lens of the eyes, in excess of 0.5 rem in any one year.] The dose in any unrestricted area from external sources, exclusive of the dose contribution from patients administered radioactive materials and released in accordance with federal regulations at 10 CFR 35.75, does not exceed 0.002 rem (0.02 millisievert) in any one hour.

(b) [The radiation level at any point outside the confines of a controlled area shall not exceed:

1. A radiation level which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour; or

2. A radiation level which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.] If the State licensee or registrant permits members of the public to have access to controlled areas, the limits for members of the public as set forth in (a) above continue to apply to those individuals.

(c) Notwithstanding (a)1 above, a State licensee may permit visitors to a patient who cannot be released under 10 CFR 35.75 to receive a radiation dose greater than 0.1 rem (1 mSv) per year if:

1. The radiation dose received does not exceed 0.5 rem (5 mSv) annually; and

2. The authorized user, as defined in 10 CFR 35.2, has determined before the visit that it is appropriate.

[c](d) A registrant or State licensee may apply to the Department, which may approve upon recommendation from the Commission, for authorization to conduct operations in such a manner that the annual dose received by an individual member of the public does not exceed 0.5 rem (5 mSv). The registrant or State licensee shall include the following information in this application:

1. Demonstration of the need for and expected duration of operations in excess of the limit in (a) above;

2. A description of the registrant's or State licensee's program to assess and control dose within the 0.5 rem (5 mSv) annual limit; and

3. [Any person may apply to the Department for proposed limits upon levels of radiation outside of controlled areas in excess of those specified in subsection (b) of the Section resulting from the applicant's possession or use of sources of radiation. Such applications shall include information as to anticipated average radiation levels and anticipated occupancy times for each area involved. The Department will approve the proposed limits if the applicant demonstrates to the satisfaction of the Department that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.] The procedures to be followed to maintain the dose as low as is reasonably achievable.

[d](e) [The limitations of this Section shall not be applicable to outgoing or incoming shipments of radioactive materials while being transported in conformance with the regulations

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of Subchapter 14 (Therapeutic Installations).] Transportation and packaging of radioactive materials must comply with all regulations of the U.S. Department of Transportation and all other agencies of the United States having jurisdiction.

(f) The Department may impose in a State license additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a State licensee may release in effluents (see the Appendix, tables 1 and 2 of subchapter 11) in order to prevent exceedence of the collective dose.

N.J.A.C. 7:28-6.5 Average concentrations

(a) Maximum permissible average concentrations of radioactive materials in air and water shall be as follows:

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		Occupational 40-hr. Week		[Non-Occupational	
Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Actinium 227	(sol.)	$6x10^{-5}$	$2x10^{-12}$	$2x10^{-6}$	$8x10^{-14}$
	(insol.)	$9x10^{-3}$	$3x10^{-11}$	$3x10^{-4}$	$9x10^{-13}$
Actinium 228	(sol.)	$3x10^{-3}$	$8x10^{-8}$	$9x10^{-5}$	$3x10^{-9}$
	(insol.)	$3x10^{-3}$	$2x10^{-8}$	$9x10^{-5}$	$6x10^{-10}$
Americium 241	(sol.)	10^{-4}	$6x10^{-12}$	$4x10^{-6}$	$2x10^{-13}$
	(insol.)	$8x10^{-4}$	10^{-10}	$2x10^{-5}$	$4x10^{-12}$
Americium 242m	(sol.)	$1x10^{-4}$	$6x10^{-12}$	$4x10^{-6}$	$2x10^{-13}$
	(insol.)	$3x10^{-3}$	$3x10^{-10}$	$9x10^{-5}$	$9x10^{-12}$
Americium 242	(sol.)	$4x10^{-3}$	$4x10^{-8}$	$1x10^{-4}$	$1x10^{-9}$
	(insol.)	$4x10^{-3}$	$5x10^{-8}$	$1x10^{-4}$	$2x10^{-9}$
Americium 243	(sol.)	10^{-4}	$6x10^{-12}$	$4x10^{-6}$	$2x10^{-13}$
	(insol.)	$8x10^{-4}$	10^{-10}	$3x10^{-5}$	$4x10^{-12}$
Americium 244	(sol.)	$1x10^{-1}$	$4x10^{-6}$	$5x10^{-3}$	$1x10^{-7}$
	(insol.)	$1x10^{-1}$	$2x10^{-5}$	$5x10^{-3}$	$8x10^{-7}$
Antimony 122	(sol.)	$8x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$6x10^{-9}$
	(insol.)	$8x10^{-4}$	10^{-7}	$3x10^{-5}$	$5x10^{-9}$
Antimony 124	(sol.)	$7x10^{-4}$	$2x10^{-7}$	$2x10^{-5}$	$5x10^{-9}$
	(insol.)	$7x10^{-4}$	$2x10^{-8}$	$2x10^{-5}$	$7x10^{-10}$
Antimony 125	(sol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$3x10^{-8}$	10^{-4}	$9x10^{-10}$
Argon 37	(imm.)	....	$6x10^{-3}$	....	10^{-4}
Argon 41	(imm.)	....	$2x10^{-6}$	....	$4x10^{-8}$
Arsenic 73	(sol.)	0.01	$2x10^{-6}$	$5x10^{-4}$	$7x10^{-8}$
	(insol.)	0.01	$4x10^{-7}$	$5x10^{-4}$	10^{-8}
Arsenic 74	(sol.)	$2x10^{-3}$	$3x10^{-7}$	$5x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	10^{-7}	$5x10^{-5}$	$4x10^{-9}$
Arsenic 76	(sol.)	$6x10^{-4}$	10^{-7}	$2x10^{-5}$	$4x10^{-9}$
	(insol.)	$6x10^{-4}$	10^{-7}	$2x10^{-5}$	$3x10^{-9}$
Arsenic	(sol.)	$2x10^{-3}$	$5x10^{-7}$	$8x10^{-5}$	$2x10^{-8}$
	(insol.)	$2x10^{-3}$	$4x10^{-7}$	$8x10^{-5}$	10^{-8}
Astatine 211	(sol.)	$5x10^{-5}$	$7x10^{-9}$	$2x10^{-6}$	$2x10^{-10}$
	(insol.)	$2x10^{-3}$	$3x10^{-8}$	$7x10^{-5}$	10^{-9}
Barium 131	(sol.)	$5x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
	(insol.)	$5x10^{-3}$	$4x10^{-7}$	$2x10^{-4}$	10^{-8}
Barium 140	(sol.)	$8x10^{-4}$	10^{-7}	$3x10^{-5}$	$4x10^{-9}$
	(insol.)	$7x10^{-4}$	$4x10^{-8}$	$2x10^{-5}$	10^{-9}

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		Occupational 40-hr. Week		Non-Occupational	
Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Berkelium 249	(sol.)	0.02	$9x10^{-10}$	$6x10^{-4}$	$3x10^{-11}$
	(insol.)	0.02	10^{-7}	$6x10^{-4}$	$4x10^{-9}$
Berkelium 250	(sol.)	$6x10^{-3}$	$1x10^{-7}$	$2x10^{-4}$	$5x10^{-9}$
	(insol.)	$6x10^{-3}$	$1x10^{-6}$	$2x10^{-4}$	$4x10^{-8}$
Beryllium 7	(sol.)	0.05	$6x10^{-6}$	0.002	$2x10^{-7}$
	(insol.)	0.05	10^{-6}	0.002	$4x10^{-8}$
Bismuth 206	(sol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$6x10^{-9}$
	(insol.)	10^{-3}	10^{-7}	$4x10^{-5}$	$5x10^{-9}$
Bismuth 207	(sol.)	$2x10^{-3}$	$2x10^{-7}$	$6x10^{-5}$	$6x10^{-9}$
	(insol.)	$2x10^{-3}$	10^{-8}	$6x10^{-5}$	$5x10^{-10}$
Bismuth 210	(sol.)	10^{-3}	$6x10^{-9}$	$4x10^{-5}$	$2x10^{-10}$
	(insol.)	10^{-3}	$6x10^{-9}$	$4x10^{-5}$	$2x10^{-10}$
Bismuth 212	(sol.)	0.01	10^{-7}	$4x10^{-4}$	$3x10^{-9}$
	(insol.)	0.01	$2x10^{-7}$	$4x10^{-4}$	$7x10^{-9}$
Bromine 82	(sol.)	$8x10^{-3}$	10^{-6}	$3x10^{-4}$	$4x10^{-8}$
	(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$6x10^{-9}$
Cadmium 109	(sol.)	$5x10^{-3}$	$5x10^{-8}$	$2x10^{-4}$	$2x10^{-9}$
	(insol.)	$5x10^{-3}$	$7x10^{-8}$	$2x10^{-4}$	$3x10^{-9}$
Cadmium 115m	(sol.)	$7x10^{-4}$	$4x10^{-8}$	$3x10^{-5}$	10^{-9}
	(insol.)	$7x10^{-4}$	$4x10^{-8}$	$3x10^{-5}$	10^{-9}
Cadmium 115	(sol.)	10^{-3}	$2x10^{-7}$	$3x10^{-5}$	$8x10^{-9}$
	(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$6x10^{-9}$
Calcium 45	(sol.)	$3x10^{-4}$	$3x10^{-8}$	$9x10^{-6}$	10^{-9}
	(insol.)	$5x10^{-3}$	10^{-7}	$2x10^{-4}$	$4x10^{-9}$
Calcium 47	(sol.)	10^{-3}	$2x10^{-7}$	$5x10^{-5}$	$6x10^{-9}$
	(insol.)	10^{-3}	$2x10^{-7}$	$3x10^{-5}$	$6x10^{-9}$
Californium 249	(sol.)	10^{-4}	$2x10^{-12}$	$4x10^{-6}$	$5x10^{-14}$
	(insol.)	$7x10^{-4}$	10^{-10}	$2x10^{-5}$	$3x10^{-12}$
Californium 250	(sol.)	$4x10^{-4}$	$5x10^{-12}$	10^{-5}	$2x10^{-13}$
	(insol.)	$7x10^{-4}$	10^{-10}	$3x10^{-5}$	$3x10^{-12}$
Californium 251	(sol.)	$1x10^{-4}$	$2x10^{-12}$	$4x10^{-6}$	$6x10^{-14}$
	(insol.)	$8x10^{-4}$	$1x10^{-10}$	$3x10^{-5}$	$3x10^{-12}$
Californium 252	(sol.)	$7x10^{-4}$	$2x10^{-11}$	$2x10^{-5}$	$7x10^{-13}$
	(insol.)	$7x10^{-4}$	10^{-10}	$2x10^{-5}$	$4x10^{-12}$
Californium 253	(sol.)	$4x10^{-3}$	$8x10^{-10}$	$1x10^{-4}$	$3x10^{-11}$
	(insol.)	$4x10^{-3}$	$8x10^{-10}$	$1x10^{-4}$	$3x10^{-11}$

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Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Californium 254	(sol.)	$4x10^{-6}$	$5x10^{-12}$	10^{-7}	$2x10^{-13}$
	(insol.)	$4x10^{-6}$	$5x10^{-12}$	10^{-7}	$2x10^{-13}$
Carbon 14	(sol.)	0.02	$4x10^{-6}$	$8x10^{-4}$	10^{-7}
	(insol.)	....	$5x10^{-5}$	....	10^{-6}
Cerium 141	(sol.)	$3x10^{-3}$	$4x10^{-7}$	$9x10^{-5}$	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$2x10^{-7}$	$9x10^{-5}$	$5x10^{-9}$
Cerium 143	(sol.)	10^{-3}	$3x10^{-7}$	$4x10^{-5}$	$9x10^{-9}$
	(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$7x10^{-9}$
Cerium 144	(sol.)	$3x10^{-4}$	10^{-8}	10^{-5}	$3x10^{-10}$
	(insol.)	$3x10^{-4}$	$6x10^{-9}$	10^{-5}	$2x10^{-10}$
Cesium 131	(sol.)	0.07	10^{-5}	0.002	$4x10^{-7}$
	(insol.)	0.03	$3x10^{-6}$	$9x10^{-4}$	10^{-7}
Cesium 134m	(sol.)	0.2	$4x10^{-5}$	0.006	10^{-6}
	(insol.)	0.03	$6x10^{-6}$	0.001	$2x10^{-7}$
Cesium 134	(sol.)	$3x10^{-4}$	$4x10^{-8}$	$9x10^{-6}$	10^{-9}
	(insol.)	10^{-3}	10^{-8}	$4x10^{-5}$	$4x10^{-10}$
Cesium 135	(sol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$7x10^{-3}$	$9x10^{-8}$	$2x10^{-4}$	$3x10^{-9}$
Cesium 136	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$9x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	$2x10^{-7}$	$6x10^{-5}$	$6x10^{-9}$
Cesium 137	(sol.)	$4x10^{-4}$	$6x10^{-8}$	$2x10^{-5}$	$2x10^{-9}$
	(insol.)	10^{-3}	10^{-8}	$4x10^{-5}$	$5x10^{-10}$
Chlorine 36	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$8x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	$2x10^{-8}$	$6x10^{-5}$	$8x10^{-10}$
Chlorine 38	(sol.)	0.01	$3x10^{-6}$	$4x10^{-4}$	$9x10^{-8}$
	(insol.)	0.01	$2x10^{-6}$	$4x10^{-4}$	$7x10^{-8}$
Chromium 51	(sol.)	0.05	10^{-5}	0.002	$4x10^{-7}$
	(insol.)	0.05	$2x10^{-6}$	0.002	$8x10^{-8}$
Cobalt 57	(sol.)	0.02	$3x10^{-6}$	$5x10^{-4}$	10^{-7}
	(insol.)	0.01	$2x10^{-7}$	$4x10^{-4}$	$6x10^{-9}$
Cobalt 58m	(sol.)	0.08	$2x10^{-5}$	0.003	$6x10^{-7}$
	(insol.)	0.06	$9x10^{-6}$	0.002	$3x10^{-7}$
Cobalt 58	(sol.)	$4x10^{-3}$	$8x10^{-7}$	10-4	$3x10^{-8}$
	(insol.)	$3x10^{-3}$	$5x10^{-8}$	$9x10^{-5}$	$2x10^{-9}$
Cobalt 60	(sol.)	10^{-3}	$3x10^{-7}$	$5x10^{-5}$	10^{-8}
	(insol.)	10^{-3}	$9x10^{-9}$	$3x10^{-5}$	$3x10^{-10}$

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Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Copper 64	(sol.)	0.01	$2x10^{-6}$	$3x10^{-4}$	$7x10^{-8}$
	(insol.)	$6x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
Curium 242	(sol.)	$7x10^{-4}$	10^{-10}	$2x10^{-5}$	$4x10^{-12}$
	(insol.)	$7x10^{-4}$	$2x10^{-10}$	$3x10^{-5}$	$6x10^{-12}$
Curium 243	(sol.)	10^{-4}	$6x10^{-12}$	$5x10^{-6}$	$2x10^{-13}$
	(insol.)	$7x10^{-4}$	10^{-10}	$2x10^{-5}$	$3x10^{-12}$
Curium 244	(sol.)	$2x10^{-4}$	$9x10^{-12}$	$7x10^{-6}$	$3x10^{-13}$
	(insol.)	$8x10^{-4}$	10^{-10}	$3x10^{-5}$	$3x10^{-12}$
Curium 245	(sol.)	10^{-4}	$5x10^{-12}$	$4x10^{-6}$	$2x10^{-13}$
	(insol.)	$8x10^{-4}$	10^{-10}	$3x10^{-5}$	$4x10^{-12}$
Curium 246	(sol.)	10^{-4}	$5x10^{-12}$	$4x10^{-6}$	$2x10^{-13}$
	(insol.)	$8x10^{-4}$	10^{-10}	$3x10^{-5}$	$4x10^{-12}$
Curium 247	(sol.)	$1x10^{-4}$	$5x10^{-12}$	$4x10^{-6}$	$2x10^{-13}$
	(insol.)	$6x10^{-4}$	$1x10^{-10}$	$2x10^{-5}$	$4x10^{-12}$
Curium 248	(sol.)	$1x10^{-5}$	$6x10^{-13}$	$4x10^{-7}$	$2x10^{-14}$
	(insol.)	$4x10^{-5}$	$1x10^{-11}$	$1x10^{-6}$	$4x10^{-13}$
Curium 249	(sol.)	$6x10^{-2}$	$1x10^{-5}$	$2x10^{-3}$	$4x10^{-7}$
	(insol.)	$6x10^{-2}$	$1x10^{-5}$	$2x10^{-3}$	$4x10^{-7}$
Dysprosium 165	(sol.)	0.01	$3x10^{-6}$	$4x10^{-4}$	$9x10^{-8}$
	(insol.)	0.01	$2x10^{-6}$	$4x10^{-4}$	$7x10^{-8}$
Dysprosium 166	(sol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$8x10^{-9}$
	(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$7x10^{-9}$
Einsteinium 253	(sol.)	$7x10^{-4}$	$8x10^{-10}$	$2x10^{-5}$	$3x10^{-11}$
	(insol.)	$7x10^{-4}$	$6x10^{-10}$	$2x10^{-5}$	$2x10^{-11}$
Einsteinium 254	(sol.)	$5x10^{-4}$	$5x10^{-9}$	$2x10^{-5}$	$2x10^{-10}$
	(insol.)	$5x10^{-4}$	$6x10^{-9}$	$2x10^{-5}$	$2x10^{-10}$
Einsteinium 254	(sol.)	$4x10^{-4}$	$2x10^{-11}$	$1x10^{-5}$	$6x10^{-13}$
	(insol.)	$4x10^{-4}$	$1x10^{-10}$	$1x10^{-5}$	$4x10^{-12}$
Einsteinium 255	(sol.)	$8x10^{-4}$	$5x10^{-10}$	$3x10^{-5}$	$2x10^{-11}$
	(insol.)	$8x10^{-4}$	$4x10^{-10}$	$3x10^{-5}$	$1x10^{-11}$
Erbium 169	(sol.)	$3x10^{-3}$	$6x10^{-7}$	$9x10^{-5}$	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$4x10^{-7}$	$9x10^{-5}$	10^{-8}
Erbium 171	(sol.)	$3x10^{-3}$	$7x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
Europium 152	(9.2 hr)				
	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$6x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	$3x10^{-7}$	$6x10^{-5}$	10^{-8}

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Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Europium 152	(13 yr.)				
	(sol.)	$2x10^{-3}$	10^{-8}	$8x10^{-5}$	$4x10^{-10}$
	(insol.)	$2x10^{-3}$	$2x10^{-8}$	$8x10^{-5}$	$6x10^{-10}$
Europium 154	(sol.)	$6x10^{-4}$	$4x10^{-9}$	$2x10^{-5}$	10^{-10}
	(insol.)	$6x10^{-4}$	$7x10^{-9}$	$2x10^{-5}$	$2x10^{-10}$
Europium 155	(sol.)	$6x10^{-3}$	$9x10^{-8}$	$2x10^{-4}$	$3x10^{-9}$
	(insol.)	$6x10^{-3}$	$7x10^{-8}$	$2x10^{-4}$	$3x10^{-9}$
Fermium 254	(sol.)	$4x10^{-3}$	$6x10^{-8}$	$1x10^{-4}$	$2x10^{-9}$
	(insol.)	$4x10^{-3}$	$7x10^{-8}$	$1x10^{-4}$	$2x10^{-9}$
Fermium 255	(sol.)	$1x10^{-3}$	$2x10^{-8}$	$3x10^{-5}$	$6x10^{-10}$
	(insol.)	$1x10^{-3}$	$1x10^{-8}$	$3x10^{-5}$	$4x10^{-10}$
Fermium 256	(sol.)	$3x10^{-5}$	$3x10^{-9}$	$9x10^{-7}$	$1x10^{-10}$
	(insol.)	$3x10^{-5}$	$2x10^{-9}$	$9x10^{-7}$	$6x10^{-11}$
Fluorine 18	(sol.)	0.02	$5x10^{-6}$	$8x10^{-4}$	$2x10^{-7}$
	(insol.)	0.01	$3x10^{-6}$	$5x10^{-4}$	$9x10^{-8}$
Gadolinium 153	(sol.)	$6x10^{-3}$	$2x10^{-7}$	$2x10^{-4}$	$8x10^{-9}$
	(insol.)	$6x10^{-3}$	$9x10^{-8}$	$2x10^{-4}$	$3x10^{-9}$
Gadolinium 159	(sol.)	$2x10^{-3}$	$5x10^{-7}$	$8x10^{-5}$	$2x10^{-8}$
	(insol.)	$2x10^{-3}$	$4x10^{-7}$	$8x10^{-5}$	10^{-8}
Gallium 72	(sol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$8x10^{-9}$
	(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$6x10^{-9}$
Germanium 71	(sol.)	0.05	10^{-5}	0.002	$4x10^{-7}$
	(insol.)	0.05	$6x10^{-6}$	0.002	$2x10^{-7}$
Gold 196	(sol.)	$5x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
	(insol.)	$4x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
Gold 198	(sol.)	$2x10^{-3}$	$3x10^{-7}$	$5x10^{-5}$	10^{-8}
	(insol.)	10^{-3}	$2x10^{-7}$	$5x10^{-5}$	$8x10^{-9}$
Gold 199	(sol.)	$5x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
	(insol.)	$4x10^{-3}$	$8x10^{-7}$	$2x10^{-4}$	$3x10^{-8}$
Hafnium 181	(sol.)	$2x10^{-3}$	$4x10^{-8}$	$7x10^{-5}$	10^{-9}
	(insol.)	$2x10^{-3}$	$7x10^{-8}$	$7x10^{-5}$	$3x10^{-9}$
Holmium 166	(sol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$7x10^{-9}$
	(insol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$6x10^{-9}$
Hydrogen 3	(sol., insol)	0.1	$5x10^{-6}$	0.003	$2x10^{-7}$
	(imm.)	....	$2x10^{-3}$	....	$4x10^{-5}$
Indium 113m	(sol.)	0.04	$8x10^{-6}$	0.001	$3x10^{-7}$
	(insol.)	0.04	$7x10^{-6}$	0.001	$2x10^{-7}$

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Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Indium 114m	(sol.)	$5x10^{-4}$	10^{-7}	$2x10^{-5}$	$4x10^{-9}$
	(insol.)	$5x10^{-4}$	$2x10^{-8}$	$2x10^{-5}$	$7x10^{-10}$
Indium 115m	(sol.)	0.01	$2x10^{-6}$	$4x10^{-4}$	$8x10^{-8}$
	(insol.)	0.01	$2x10^{-6}$	$4x10^{-4}$	$6x10^{-8}$
Indium 115	(sol.)	$3x10^{-3}$	$2x10^{-7}$	$9x10^{-5}$	$9x10^{-9}$
	(insol.)	$3x10^{-3}$	$3x10^{-8}$	$9x10^{-5}$	10^{-9}
Iodine 125	(sol.)	$4x10^{-3}$	$5x10^{-9}$	$2x10^{-7}$	$8x10^{-11}$
	(insol.)	$6x10^{-3}$	$2x10^{-7}$	$2x10^{-4}$	$6x10^{-9}$
Iodine 126	(sol.)	$5x10^{-5}$	$8x10^{-9}$	$3x10^{-7}$	$9x10^{-11}$
	(insol.)	$3x10^{-7}$	$3x10^{-7}$	$9x10^{-5}$	10^{-8}
Iodine 129	(sol.)	10^{-5}	$2x10^{-9}$	$6x10^{-8}$	$2x10^{-11}$
	(insol.)	$6x10^{-3}$	$7x10^{-8}$	$2x10^{-4}$	$2x10^{-9}$
Iodine 131	(sol.)	$6x10^{-5}$	$9x10^{-9}$	$3x10^{-7}$	$1x10^{-10}$
	(insol.)	$2x10^{-3}$	$3x10^{-7}$	$6x10^{-5}$	10^{-8}
Iodine 132	(sol.)	$2x10^{-3}$	$2x10^{-7}$	$8x10^{-6}$	$3x10^{-9}$
	(insol.)	$5x10^{-3}$	$9x10^{-7}$	$2x10^{-4}$	$3x10^{-8}$
Iodine 133	(sol.)	$2x10^{-4}$	$3x10^{-8}$	$1x10^{-6}$	$4x10^{-10}$
	(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$7x10^{-9}$
Iodine 134	(sol.)	$4x10^{-3}$	$5x10^{-7}$	$2x10^{-5}$	$6x10^{-9}$
	(insol.)	0.02	$3x10^{-6}$	$6x10^{-4}$	10^{-7}
Iodine 135	(sol.)	$7x10^{-4}$	10^{-7}	$4x10^{-6}$	$1x10^{-9}$
	(insol.)	$2x10^{-3}$	$4x10^{-7}$	$7x10^{-5}$	10^{-8}
Iridium 190	(sol.)	$6x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
	(insol.)	$5x10^{-3}$	$4x10^{-7}$	$2x10^{-4}$	10^{-8}
Iridium 192	(sol.)	10^{3}	10^{-7}	$4x10^{-5}$	$4x10^{-9}$
	(insol.)	10^{-3}	$3x10^{-8}$	$4x10^{-5}$	$9x10^{-10}$
Iridium 194	(sol.)	10^{-3}	$2x10^{-7}$	$3x10^{-5}$	$8x10^{-9}$
	(insol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$5x10^{-9}$
Iron 55	(sol.)	0.02	$9x10^{-7}$	$8x10^{-4}$	$3x10^{-8}$
	(insol.)	0.07	10^{-6}	0.002	$3x10^{-8}$
Iron 59	(sol.)	$2x10^{-3}$	10^{-7}	$6x10^{-5}$	$5x10^{-9}$
	(insol.)	$2x10^{-3}$	$5x10^{-8}$	$5x10^{-5}$	$2x10^{-9}$
Krypton 85m	(imm.)	. . .	$6x10^{-6}$	. . .	10^{-7}
Krypton 85	(imm.)	. . .	10^{-5}	. . .	$3x10^{-7}$
Krypton 87	(imm.)	. . .	10^{-6}	. . .	$2x10^{-8}$
Lanthanum 140	(sol.)	$7x10^{-4}$	$2x10^{-7}$	$2x10^{-5}$	$5x10^{-9}$
	(insol.)	$7x10^{-4}$	10^{-7}	$2x10^{-5}$	$4x10^{-9}$

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Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Lead 203	(sol.)	0.01	$3x10^{-6}$	$4x10^{-4}$	$9x10^{-8}$
	(insol.)	0.01	$2x10^{-6}$	$4x10^{-4}$	$6x10^{-8}$
Lead 210	(sol.)	$4x10^{-6}$	10^{-10}	10^{7}	$4x10^{-12}$
	(insol.)	$5x10^{-3}$	$2x10^{-10}$	$2x10^{-4}$	$8x10^{-12}$
Lead 212	(sol.)	$6x10^{-4}$	$2x10^{-8}$	$2x10^{-5}$	$6x10^{-10}$
	(insol.)	$5x10^{-4}$	$2x10^{-8}$	$2x10^{-5}$	$7x10^{-10}$
Lutetium 177	(sol.)	$3x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
Manganese 52	(sol.)	10^{-3}	$2x10^{-7}$	$3x10^{-5}$	$7x10^{-9}$
	(insol.)	$9x10^{-4}$	10^{-7}	$3x10^{-5}$	$5x10^{-9}$
Manganese 54	(sol.)	$4x10^{-3}$	$4x10^{-7}$	10^{-4}	10^{-8}
	(insol.)	$3x10^{-3}$	$4x10^{-8}$	10^{-4}	10^{-9}
Manganese 56	(sol.)	$4x10^{-3}$	$8x10^{-7}$	10^{-4}	$3x10^{-8}$
	(insol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
Mercury 197m	(sol.)	$6x10^{-3}$	$7x10^{-7}$	$2x10^{-4}$	$3x10^{-8}$
	(insol.)	$5x10^{-3}$	$8x10^{-7}$	$2x10^{-4}$	$3x10^{-8}$
Mercury 197	(sol.)	$9x10^{-3}$	10^{-6}	$3x10^{-4}$	$4x10^{-8}$
	(insol.)	0.01	$3x10^{-6}$	$5x10^{-4}$	$9x10^{-8}$
Mercury 203	(sol.)	$5x10^{-4}$	$7x10^{-8}$	$2x10^{-5}$	$2x10^{-9}$
	(insol.)	$3x10^{-3}$	10^{-7}	10^{-4}	$4x10^{-9}$
Molybdenum 99	(sol.)	$5x10^{-3}$	$7x10^{-7}$	$2x10^{-4}$	$3x10^{-8}$
	(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$7x10^{-9}$
Neodymium 144	(sol.)	$2x10^{-3}$	$8x10^{-11}$	$7x10^{-5}$	$3x10^{-12}$
	(insol.)	$2x10^{-3}$	$3x10^{-10}$	$8x10^{-5}$	10^{-11}
Neodymium 147	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$6x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	$2x10^{-7}$	$6x10^{-5}$	$8x10^{-9}$
Neodymium 149	(sol.)	$8x10^{-3}$	$2x10^{-6}$	$3x10^{-4}$	$6x10^{-8}$
	(insol.)	$8x10^{-3}$	10^{-6}	$3x10^{-4}$	$5x10^{-8}$
Neptunium 237	(sol.)	$9x10^{-5}$	$4x10^{-12}$	$3x10^{-6}$	10^{-13}
	(insol.)	$9x10^{-4}$	10^{-10}	$3x10^{-5}$	$4x10^{-12}$
Neptunium 239	(sol.)	$4x10^{-3}$	$8x10^{-7}$	10^{-4}	$3x10^{-8}$
	(insol.)	$4x10^{-3}$	$7x10^{-7}$	10^{-4}	$2x10^{-8}$
Nickel 59	(sol.)	$6x10^{-3}$	$5x10^{-7}$	$2x10^{-4}$	$2x10^{-8}$
	(insol.)	0.06	$8x10^{-7}$	0.002	$3x10^{-8}$
Nickel 63	(sol.)	$8x10^{-4}$	$6x10^{-8}$	$3x10^{-5}$	$2x10^{-9}$
	(insol.)	0.02	$3x10^{-7}$	$7x10^{-4}$	10^{-8}

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Column		A	B	C	D
Nickel 65	(sol.)	$4x10^{-3}$	$9x10^{-7}$	10^{-4}	$3x10^{-8}$
	(insol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
Niobium 93m	(sol.)	0.01	10^{-7}	$4x10^{-4}$	$4x10^{-9}$
	(insol.)	0.01	$2x10^{-7}$	$4x10^{-4}$	$5x10^{-9}$
Niobium 95	(sol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	10^{-7}	10^{-4}	$3x10^{-9}$
Niobium 97	(sol.)	0.03	$6x10^{-6}$	$9x10^{-4}$	$2x10^{-7}$
	(insol.)	0.03	$5x10^{-6}$	$9x10^{-4}$	$2x10^{-7}$
Osmium 185	(sol.)	$2x10^{-3}$	$5x10^{-7}$	$7x10^{-5}$	$2x10^{-8}$
	(insol.)	$2x10^{-3}$	$5x10^{-8}$	$7x10^{-5}$	$2x10^{-9}$
Osmium 191m	(sol.)	0.07	$2x10^{-5}$	0.003	$6x10^{-7}$
	(insol.)	0.07	$9x10^{-6}$	0.002	$3x10^{-7}$
Osmium 191	(sol.)	$5x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
	(insol.)	$5x10^{-3}$	$4x10^{-7}$	$2x10^{-4}$	10^{-8}
Osmium 193	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$6x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	$3x10^{-7}$	$5x10^{-5}$	$9x10^{-9}$
Palladium 103	(sol.)	0.01	10^{-6}	$3x10^{-4}$	$5x10^{-8}$
	(insol.)	$8x10^{-3}$	$7x10^{-7}$	$3x10^{-4}$	$3x10^{-8}$
Palladium 109	(sol.)	$3x10^{-3}$	$6x10^{-7}$	$9x10^{-5}$	$2x10^{-8}$
	(insol.)	$2x10^{-3}$	$4x10^{-7}$	$7x10^{-5}$	10^{-8}
Phosphorus 32	(sol.)	$5x10^{-4}$	$7x10^{-8}$	$2x10^{-5}$	$2x10^{-9}$
	(insol.)	$7x10^{-4}$	$8x10^{-8}$	$2x10^{-5}$	$3x10^{-9}$
Platinum 191	(sol.)	$4x10^{-3}$	$8x10^{-7}$	10^{-4}	$3x10^{-8}$
	(insol.)	$3x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
Platinum 193m	(sol.)	0.03	$7x10^{-6}$	0.001	$2x10^{-7}$
	(insol.)	0.03	$5x10^{-6}$	0.001	$2x10^{-7}$
Platinum 193	(sol.)	0.03	10^{-6}	$9x10^{-4}$	$4x10^{-8}$
	(insol.)	0.05	$3x10^{-7}$	0.002	10^{-8}
Platinum 197m	(sol.)	0.03	$6x10^{-6}$	0.001	$2x10^{-7}$
	(insol.)	0.03	$5x10^{-6}$	$9x10^{-4}$	$2x10^{-7}$
Platinum 197	(sol.)	$4x10^{-3}$	$8x10^{-7}$	10^{-4}	$3x10^{-8}$
	(insol.)	$3x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
Plutonium 238	(sol.)	10^{-4}	$2x10^{-12}$	$5x10^{-6}$	$7x10^{-14}$
	(insol.)	$8x10^{-4}$	$3x10^{-11}$	$3x10^{-5}$	10^{-12}
Plutonium 239	(sol.)	10^{-4}	$2x10^{-12}$	$5x10^{-6}$	$6x10^{-14}$
	(insol.)	$8x10^{-4}$	$4x10^{-11}$	$3x10^{-5}$	10^{-12}

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Column	A	B	C	D
Plutonium 240(sol.)	10^{-4}	$2x10^{-12}$	$5x10^{-6}$	$6x10^{-14}$
(insol.)	$8x10^{-4}$	$4x10^{-11}$	$3x10^{-5}$	10^{-12}
Plutonium 241(sol.)	$7x10^{-3}$	$9x10^{-11}$	$2x10^{-4}$	$3x10^{-12}$
(insol.)	0.04	$4x10^{-8}$	0.001	10^{-9}
Plutonium 242(sol.)	10^{-4}	$2x10^{-12}$	$5x10^{-6}$	$6x10^{-14}$
(insol.)	$9x10^{-4}$	$4x10^{-11}$	$3x10^{-5}$	10^{-12}
Plutonium 243(sol.)	$1x10^{-2}$	$2x10^{-6}$	$3x10^{-4}$	$6x10^{-8}$
(insol.)	$1x10^{-2}$	$2x10^{-6}$	$3x10^{-4}$	$8x10^{-8}$
Plutonium 244(sol.)	$1x10^{-4}$	$2x10^{-12}$	$4x10^{-6}$	$6x10^{-14}$
(insol.)	$3x10^{-4}$	$3x10^{-11}$	$1x10^{-5}$	$1x10^{-12}$
Polonium 210 (sol.)	$2x10^{-5}$	$5x10^{-10}$	$7x10^{-7}$	$2x10^{-11}$
(insol.)	$8x10^{-4}$	$2x10^{-10}$	$3x10^{-5}$	$7x10^{-12}$
Potassium 42 (sol.)	$9x10^{-3}$	$2x10^{-6}$	$3x10^{-4}$	$7x10^{-8}$
(insol.)	$6x10^{-4}$	10^{-7}	$2x10^{-5}$	$4x10^{-9}$
Praseodymium 142(sol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$7x10^{-9}$
(insol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$5x10^{-9}$
Praseodymium 143(sol.)	10^{-3}	$3x10^{-7}$	$5x10^{-5}$	10^{-8}
(insol.)	10^{-3}	$2x10^{-7}$	$5x10^{-5}$	$6x10^{-9}$
Promethium 147(sol.)	$6x10^{-3}$	$6x10^{-8}$	$2x10^{-4}$	$2x10^{-9}$
(insol.)	$6x10^{-3}$	10^{-7}	$2x10^{-4}$	$3x10^{-9}$
Promethium 149(sol.)	10^{-3}	$3x10^{-7}$	$4x10^{-5}$	10^{-8}
(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$8x10^{-9}$
Protactinium 230(sol.)	$7x10^{-3}$	$2x10^{-9}$	$2x10^{-4}$	$6x10^{-11}$
(insol.)	$7x10^{-3}$	$8x10^{-10}$	$2x10^{-4}$	$3x10^{-11}$
Protactinium 231(sol.)	$3x10^{-5}$	10^{-12}	$9x10^{-7}$	$4x10^{-14}$
(insol.)	$8x10^{-4}$	10^{-10}	$2x10^{-5}$	$4x10^{-12}$
Protactinium 233(sol.)	$4x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
(insol.)	$3x10^{-3}$	$2x10^{-7}$	10^{-4}	$6x10^{-9}$
Radium 223 (sol.)	$2x10^{-5}$	$2x10^{-9}$	$7x10^{-7}$	$6x10^{-11}$
(insol.)	10^{-4}	$2x10^{-10}$	$4x10^{-6}$	$8x10^{-12}$
Radium 224 (sol.)	$7x10^{-5}$	$5x10^{-9}$	$2x10^{-6}$	$2x10^{-10}$
(insol.)	$2x10^{-4}$	$7x10^{-10}$	$5x10^{-6}$	$2x10^{-11}$
Radium 226 (sol.)	$4x10^{-7}$	$3x10^{-11}$	$3x10^{-8}$	$3x10^{-12}$
(insol.)	$9x10^{-4}$	$5x10^{-11}$	$3x10^{-5}$	$2x10^{-12}$
Radium 228 (sol.)	$8x10^{-7}$	$7x10^{-11}$	$3x10^{-8}$	$2x10^{-12}$
(insol.)	$7x10^{-4}$	$4x10^{-11}$	$3x10^{-5}$	10^{-12}

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		Occupational 40-hr. Week		Non-Occupational	
Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Radon 220		. . .	$3x10^{-7}$	. . .	10^{-8}
Radon 222		. . .	$3x10^{-8}$	. . .	$1x10^{-9}$
Rhenium 183	(sol.)	0.02	$3x10^{-6}$	$6x10^{-4}$	$9x10^{-8}$
	(insol.)	$8x10^{-3}$	$2x10^{-7}$	$3x10^{-4}$	$5x10^{-9}$
Rhenium 186	(sol.)	$3x10^{-3}$	$6x10^{-7}$	$9x10^{-5}$	$2x10^{-8}$
	(insol.)	10^{-3}	$2x10^{-7}$	$5x10^{-5}$	$8x10^{-9}$
Rhenium 187	(sol.)	0.07	$9x10^{-6}$	0.003	$3x10^{-7}$
	(insol.)	0.04	$5x10^{-7}$	0.002	$2x10^{-8}$
Rhenium 188	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$6x10^{-5}$	10^{-8}
	(insol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$6x10^{-9}$
Rhodium 103m	(sol.)	0.4	$8x10^{-5}$	0.01	$3x10^{-6}$
	(insol.)	0.3	$6x10^{-5}$	0.01	$2x10^{-6}$
Rhodium 105	(sol.)	$4x10^{-3}$	$8x10^{-7}$	10^{-4}	$3x10^{-8}$
	(insol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
Rubidium 86	(sol.)	$2x10^{-3}$	$3x10^{-7}$	$7x10^{-5}$	10^{-8}
	(insol.)	$7x10^{-4}$	$7x10^{-8}$	$2x10^{-5}$	$2x10^{-9}$
Rubidium 87	(sol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$5x10^{-3}$	$7x10^{-8}$	$2x10^{-4}$	$2x10^{-9}$
Ruthenium 97	(sol.)	0.01	$2x10^{-6}$	$4x10^{-4}$	$8x10^{-8}$
	(insol.)	0.01	$2x10^{-6}$	$3x10^{-4}$	$6x10^{-8}$
Ruthenium 103	(sol.)	$2x10^{-3}$	$5x10^{-7}$	$8x10^{-5}$	$2x10^{-8}$
	(insol.)	$2x10^{-3}$	$8x10^{-8}$	$8x10^{-5}$	$3x10^{-9}$
Ruthenium 105	(sol.)	$3x10^{-3}$	$7x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$5x10^{-7}$	10^{-4}	$2x10^{-8}$
Ruthenium 106	(sol.)	$4x10^{-4}$	$8x10^{-8}$	10^{-5}	$3x10^{-9}$
	(insol.)	$3x10^{-4}$	$6x10^{-9}$	10^{-5}	$2x10^{-10}$
Samarium 147	(sol.)	$2x10^{-3}$	$7x10^{-11}$	$6x10^{-5}$	$2x10^{-12}$
	(insol.)	$2x10^{-3}$	$3x10^{-10}$	$7x10^{-5}$	$9x10^{-12}$
Samarium 151	(sol.)	0.01	$6x10^{-8}$	$4x10^{-4}$	$2x10^{-9}$
	(insol.)	0.01	10^{-7}	$4x10^{-4}$	$5x10^{-9}$
Samarium 153	(sol.)	$2x10^{-3}$	$5x10^{-7}$	$8x10^{-5}$	$2x10^{-8}$
	(insol.)	$2x10^{-3}$	$4x10^{-7}$	$8x10^{-5}$	10^{-8}
Scandium 46	(sol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$8x10^{-9}$
	(insol.)	10^{-3}	$2x10^{-8}$	$4x10^{-5}$	$8x10^{-10}$
Scandium 47	(sol.)	$3x10^{-3}$	$6x10^{-7}$	$9x10^{-5}$	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$5x10^{-7}$	$9x10^{-5}$	$2x10^{-8}$

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		Occupational 40-hr. Week		Non-Occupational	
Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Scandium 48	(sol.)	$8x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$6x10^{-9}$
	(insol.)	$8x10^{-4}$	10^{-7}	$3x10^{-5}$	$5x10^{-9}$
Selenium 75	(sol.)	$9x10^{-3}$	10^{-6}	$3x10^{-4}$	$4x10^{-8}$
	(insol.)	$8x10^{-3}$	10^{-7}	$3x10^{-4}$	$4x10^{-9}$
Silicon 31	(sol.)	0.03	$6x10^{-6}$	$9x10^{-4}$	$2x10^{-7}$
	(insol.)	$6x10^{-3}$	10^{-6}	$2x10^{-4}$	$3x10^{-8}$
Silver 105	(sol.)	$3x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$8x10^{-8}$	10^{-4}	$3x10^{-9}$
Silver 110m	(sol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$7x10^{-9}$
	(insol.)	$9x10^{-4}$	10^{-8}	$3x10^{-5}$	$3x10^{-10}$
Silver 111	(sol.)	10^{-3}	$3x10^{-7}$	$4x10^{-5}$	10^{-8}
	(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$8x10^{-9}$
Sodium 22	(sol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$6x10^{-9}$
	(insol.)	$9x10^{-4}$	$9x10^{-9}$	$3x10^{-5}$	$3x10^{-10}$
Sodium 24	(sol.)	$6x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
	insol.)	$8x10^{-4}$	10^{-7}	$3x10^{-5}$	$5x10^{-9}$
Strontium 85m	(sol.)	0.2	$4x10^{-5}$	0.007	10^{-6}
	(insol.)	0.2	$3x10^{-5}$	0.007	10^{-6}
Strontium 85	(sol.)	$3x10^{-3}$	$2x10^{-7}$	10^{-4}	$8x10^{-9}$
	(insol.)	$5x10^{-3}$	10^{-7}	$2x10^{-4}$	$4x10^{-9}$
Strontium 89	(sol.)	$3x10^{-4}$	$3x10^{-8}$	$3x10^{-6}$	$3x10^{-10}$
	(insol.)	$8x10^{-4}$	$4x10^{-8}$	$3x10^{-5}$	10^{-9}
Strontium 90	(sol.)	$1x10^{-5}$	$1x10^{-9}$	$4x10^{-7}$	$4x10^{-11}$
	(insol.)	10^{-3}	$5x10^{-9}$	$4x10^{-5}$	$2x10^{-10}$
Strontium 91	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$7x10^{-5}$	$2x10^{-8}$
	(insol.)	10^{-3}	$3x10^{-7}$	$5x10^{-5}$	$9x10^{-9}$
Strontium 92	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$7x10^{-5}$	$2x10^{-8}$
	(insol.)	$2x10^{-3}$	$3x10^{-7}$	$6x10^{-5}$	10^{-8}
Sulfur 35	(sol.)	$2x10^{-3}$	$3x10^{-7}$	$6x10^{-5}$	$9x10^{-9}$
	(insol.)	$8x10^{-3}$	$3x10^{-7}$	$3x10^{-4}$	$9x10^{-9}$
Tantalum 182	(sol.)	10^{-3}	$4x10^{-8}$	$4x10^{-5}$	10^{-9}
	(insol.)	10^{-3}	$2x10^{-8}$	$4x10^{-5}$	$7x10^{-10}$
Technetium 96m	(sol.)	0.4	$8x10^{-5}$	0.01	$3x10^{-6}$
	(insol.)	0.3	$3x10^{-5}$	0.01	10^{-6}
Technetium 96	(sol.)	$3x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	10^{-3}	$2x10^{-7}$	$5x10^{-5}$	$8x10^{-9}$

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	Occupational 40-hr. Week		Non-Occupational	
Radionuclide	Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column	A	B	C	D
Technetium 97m(sol.)	0.01	$2x10^{-6}$	$4x10^{-4}$	$8x10^{-9}$
(insol.)	$5x10^{-3}$	$2x10^{-7}$	$2x10^{-4}$	$5x10^{-9}$
Technetium 97(sol.)	0.05	10^{-5}	0.002	$4x10^{-7}$
(insol.)	0.02	$3x10^{-7}$	$8x10^{-4}$	10^{-8}
Technetium 99m(sol.)	0.2	$4x10^{-5}$	0.006	10^{-6}
(insol.)	0.08	10^{-5}	0.003	$5x10^{-7}$
Technetium 99(sol.)	0.01	$2x10^{-6}$	$3x10^{-4}$	$7x10^{-8}$
(insol.)	$5x10^{-3}$	$6x10^{-8}$	$2x10^{-4}$	$2x10^{-9}$
Tellurium 125m(sol.)	$5x10^{-3}$	$4x10^{-7}$	$2x10^{-4}$	10^{-8}
(insol.)	$3x10^{-3}$	10^{-7}	10^{-4}	$4x10^{-9}$
Tellurium 127m(sol.)	$2x10^{-3}$	10^{-7}	$6x10^{-5}$	$5x10^{-9}$
(insol.)	$2x10^{-3}$	$4x10^{-8}$	$5x10^{-5}$	10^{-9}
Tellurium 127 (sol.)	$8x10^{-3}$	$2x10^{-6}$	$3x10^{-4}$	$6x10^{-8}$
(insol.)	$5x10^{-3}$	$9x10^{-7}$	$2x10^{-4}$	$3x10^{-8}$
Tellurium 129m(sol.)	10^{-3}	$8x10^{-8}$	$3x10^{-5}$	$3x10^{-9}$
(insol.)	$6x10^{-4}$	$3x10^{-8}$	$2x10^{-5}$	10^{-9}
Tellurium 129 (sol.)	0.02	$5x10^{-6}$	$8x10^{-4}$	$2x10^{-7}$
(insol.)	0.02	$4x10^{-6}$	$8x10^{-4}$	10^{-7}
Tellurium 131m(sol.)	$2x10^{-3}$	$4x10^{-7}$	$6x10^{-5}$	10^{-8}
(insol.)	10^{-3}	$2x10^{-7}$	$4x10^{-5}$	$6x10^{-9}$
Tellurium 132 (sol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$7x10^{-9}$
(insol.)	$6x10^{-4}$	10^{-7}	$2x10^{-5}$	$4x10^{-9}$
Terbium 160 (sol.)	10^{-3}	10^{-7}	$4x10^{-5}$	$3x10^{-9}$
(insol.)	10^{-3}	$3x10^{-8}$	$4x10^{-5}$	10^{-9}
Thallium 200 (sol.)	0.01	$3x10^{-6}$	$4x10^{-4}$	$9x10^{-8}$
(insol.)	$7x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
Thallium 201 (sol.)	$9x10^{-3}$	$2x10^{-6}$	$3x10^{-4}$	$7x10^{-8}$
(insol.)	$5x10^{-3}$	$9x10^{-7}$	$2x10^{-4}$	$3x10^{-8}$
Thallium 202 (sol.)	$4x10^{-3}$	$8x10^{-7}$	10^{-4}	$3x10^{-8}$
(insol.)	$2x10^{-3}$	$2x10^{-7}$	$7x10^{-5}$	$8x10^{-9}$
Thallium 204 (sol.)	$3x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
(insol.)	$2x10^{-3}$	$3x10^{-8}$	$6x10^{-5}$	$9x10^{-10}$
Thorium 227 (sol.)	$5x10^{-4}$	$3x10^{-10}$	$2x10^{-5}$	10^{-11}
(insol.)	$5x10^{-4}$	$2x10^{-10}$	$2x10^{-5}$	$6x10^{-12}$
Thorium 228 (sol.)	$2x10^{-4}$	$9x10^{-12}$	$7x10^{-6}$	$3x10^{-13}$
(insol.)	$4x10^{-4}$	$6x10^{-12}$	10^{-5}	$2x10^{-13}$

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		Occupational 40-hr. Week		Non-Occupational	
Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Thorium 230	(sol.)	$5x10^{-5}$	$2x10^{-12}$	$2x10^{-6}$	$8x10^{-14}$
	(insol.)	$9x10^{-4}$	10^{-11}	$3x10^{-5}$	$3x10^{-13}$
Thorium 231	(sol.)	$7x10^{-3}$	10^{-6}	$2x10^{-4}$	$5x10^{-8}$
	(insol.)	$7x10^{-3}$	10^{-6}	$2x10^{-4}$	$4x10^{-8}$
Thorium 232	(sol.)	$5x10^{-5}$	$3x10^{-11}$	$2x10^{-6}$	10^{-12}
	(insol.)	10^{-3}	$3x10^{-11}$	$4x10^{-5}$	10^{-12}
Thorium 234	(sol.)	$5x10^{-4}$	$6x10^{-8}$	$2x10^{-5}$	$2x10^{-9}$
	(insol.)	$5x10^{-4}$	$3x10^{-8}$	$2x10^{-5}$	10^{-9}
Thorium Nat.	(sol.)	$3x10^{-5}$	$3x10^{-11}$	10^{-6}	10^{-12}
	(insol.)	$3x10^{-4}$	$3x10^{-11}$	10^{-5}	10^{-12}
Thulium 170	(sol.)	10^{-3}	$4x10^{-8}$	$5x10^{-5}$	10^{-9}
	(insol.)	10^{-3}	$3x10^{-8}$	$5x10^{-5}$	10^{-9}
Thulium 171	(sol.)	0.01	10^{-7}	$5x10^{-4}$	$4x10^{-9}$
	(insol.)	0.01	$2x10^{-7}$	$5x10^{-4}$	$8x10^{-9}$
Tin 113	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$9x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	$5x10^{-8}$	$8x10^{-5}$	$2x10^{-9}$
Tin 125	(sol.)	$5x10^{-4}$	10^{-7}	$2x10^{-5}$	$4x10^{-9}$
	(insol.)	$5x10^{-4}$	$8x10^{-8}$	$2x10^{-5}$	$3x10^{-9}$
Tungsten 181	(sol.)	0.01	$2x10^{-6}$	$4x10^{-4}$	$8x10^{-8}$
	(insol.)	0.01	10^{-7}	$3x10^{-4}$	$4x10^{-9}$
Tungsten 185	(sol.)	$4x10^{-3}$	$8x10^{-7}$	10^{-4}	$3x10^{-8}$
	(insol.)	$3x10^{-3}$	10^{-7}	10^{-4}	$4x10^{-9}$
Tungsten 187	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$7x10^{-5}$	$2x10^{-8}$
	(insol.)	$2x10^{-3}$	$3x10^{-7}$	$6x10^{-5}$	10^{-8}
Uranium 230	(sol.)	$7x10^{-5}$	$3x10^{10}$	$2x10^{-6}$	10^{-11}
	(insol.)	10^{-4}	10^{-10}	$5x10^{-6}$	$4x10^{-12}$
Uranium 232	(sol.)	$2x10^{-5}$	10^{-10}	$8x10^{-7}$	$3x10^{-12}$
	(insol.)	$8x10^{-4}$	$3x10^{-11}$	$3x10^{-5}$	$9x10^{-13}$
Uranium 233	(sol.)	10^{-4}	$5x10^{-10}$	$4x10^{-6}$	$2x10^{-11}$
	(insol.)	$9x10^{-10}$	10^{-10}	$3x10^{-5}$	$4x10^{-12}$
Uranium 234	(sol.)	10^{-4}	$6x10^{-10}$	$4x10^{-6}$	$2x10^{-11}$
	(insol.)	$9x10^{-4}$	10^{-10}	$3x10^{-5}$	$4x10^{-12}$
Uranium 235	(sol.)	10^{-4}	$5x10^{-10}$	$4x10^{-6}$	$2x10^{-11}$
	(insol.)	$8x10^{-4}$	10^{-10}	$3x10^{-5}$	$4x10^{-12}$
Uranium 236	(sol.)	10^{-4}	$6x10^{-10}$	$5x10^{-6}$	$2x10^{-11}$
	(insol.)	10^{-3}	10^{-10}	$3x10^{-5}$	$4x10^{-12}$

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		Occupational 40-hr. Week		Non-Occupational	
Radionuclide		Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column		A	B	C	D
Uranium 238	(sol.)	$2x10^{-5}$	$7x10^{-11}$	$6x10^{-7}$	$3x10^{-12}$
	(insol.)	10^{-3}	10^{-10}	$4x10^{-5}$	$5x10^{-12}$
Uranium 240 &	(sol.)	$1x10^{-3}$	$2x10^{-7}$	$3x10^{-5}$	$8x10^{-9}$
Neptunium240	(insol.)	$1x10^{-3}$	$2x10^{-7}$	$3x10^{-5}$	$6x10^{-9}$
Uranium-Nat.	(sol.)	$2x10^{-5}$	$7x10^{-11}$	$6x10^{-7}$	$3x10^{-12}$
	(insol.)	$5x10^{-4}$	$6x10^{-11}$	$2x10^{-5}$	$2x10^{-12}$
Vanadium 48	(sol.)	$9x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$6x10^{-9}$
	(insol.)	$8x10^{-4}$	$6x10^{-8}$	$3x10^{-5}$	$2x10^{-9}$
Xenon 131m	(imm.)	. . .	$2x10^{-5}$	. . .	$4x10^{-7}$
Xenon 133	(imm.)	. . .	10^{-5}	. . .	$3x10^{-7}$
Xenon 133m	(imm.)	. . .	$1x10^{-5}$	. . .	$3x10^{-7}$
Xenon 135	(imm.)	. . .	$4x10^{-6}$	. . .	10^{-7}
Ytterbium 175	(sol.)	$3x10^{-3}$	$7x10^{-7}$	10^{-4}	$2x10^{-8}$
	(insol.)	$3x10^{-3}$	$6x10^{-7}$	10^{-4}	$2x10^{-8}$
Yttrium 90	(sol.)	$6x10^{-4}$	10^{-7}	$2x10^{-5}$	$4x10^{-9}$
	(insol.)	$6x10^{-4}$	10^{-7}	$2x10^{-5}$	$3x10^{-9}$
Yttrium 91m	(sol.)	0.1	$2x10^{-5}$	0.003	$8x10^{-7}$
	(insol.)	0.1	$2x10^{-5}$	0.003	$6x10^{-7}$
Yttrium 91	(sol.)	$8x10^{-4}$	$4x10^{-8}$	$3x10^{-5}$	10^{-9}
	(insol.)	$8x10^{-4}$	$3x10^{-8}$	$3x10^{-5}$	10^{-9}
Yttrium 92	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$6x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	$3x10^{-7}$	$6x10^{-5}$	10^{-8}
Yttrium 93	(sol.)	$8x10^{-4}$	$2x10^{-7}$	$3x10^{-5}$	$6x10^{-9}$
	(insol.)	$8x10^{-4}$	10^{-7}	$3x10^{-5}$	$5x10^{-9}$
Zinc 65	(sol.)	$3x10^{-3}$	10^{-7}	10^{-4}	$4x10^{-9}$
	(insol.)	$5x10^{-3}$	$6x10^{-8}$	$2x10^{-4}$	$2x10^{-9}$
Zinc 69m	(sol.)	$2x10^{-3}$	$4x10^{-7}$	$7x10^{-5}$	10^{-8}
	(insol.)	$2x10^{-3}$	$3x10^{-7}$	$6x10^{-5}$	10^{-8}
Zinc 69	(sol.)	0.05	$7x10^{-6}$	0.002	$2x10^{-7}$
	(insol.)	0.05	$9x10^{-6}$	0.002	$3x10^{-7}$
Zirconium 93	(sol.)	0.02	10^{-7}	$8x10^{-4}$	$4x10^{-9}$
	(insol.)	0.02	$3x10^{-7}$	$8x10^{-4}$	10^{-8}
Zirconium 95	(sol.)	$2x10^{-3}$	10^{-7}	$6x10^{-5}$	$4x10^{-9}$
	(insol.)	$2x10^{-3}$	$3x10^{-8}$	$6x10^{-5}$	10^{-9}
Zirconium 97	(sol.)	$5x10^{-4}$	10^{-7}	$2x10^{-5}$	$4x10^{-9}$
	(insol.)	$5x10^{-4}$	$9x10^{-8}$	$2x10^{-5}$	$3x10^{-9}$

	Occupational 40-hr. Week		Non-Occupational	
Radionuclide	Water uc/ml	Air uc/ml	Water uc/ml	Air uc/ml
Column	A	B	C	D
Unidentified Radionuclides	$3x10^{-7}$	$1x10^{-12}$	10^{-8}	$4x10^{-14}$]

Abbreviations-- sol. = soluble

insol. = insoluble

imm. = immersion

m = metastable

(b) In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of this Section shall be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values shall be derived as follows:

i. Determine, for each radionuclide in the mixture, [the ratio between the quantity present in the mixture,] the ratio between the quantity present in the mixture and the limit otherwise established in this Section for the specific radionuclide when not in a mixture.

ii.-iii. (No change.)

2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of this section are:

i. For purposes of Column A -- $3x10^{-7}$

ii. For purposes of Column B -- $1x10^{-12}$

[iii. For purposes of Column C -- $1x10^{-8}$]

[iv. For purposes of Column D -- $4x10^{-14}$]

3. (No change.)

4. If the mixture of radionuclides consists of uranium and its daughter products in ore dust prior to chemical processing of the uranium ore, the values specified in this paragraph may be used in lieu of those determined in accordance with paragraph 1 of this subsection, or those specified in paragraphs 2 and 3 of this subsection.

i. (No change.)

[ii. For purposes of subsection (a) of this Section, Column D, $3x10^{-13}$ uc/ml gross alpha activity; or $8x10^{-13}$ uc/ml natural uranium; or 3 micrograms per cubic meter of air natural uranium.]

[5. For purposes of this subsection, a radionuclide may be considered as not present in a mixture if:

i. The ratio of the concentration of that radionuclide in the mixture (C_a) to the concentration limit for the radionuclide specified in Columns C and D of subsection (a) of this Section, (MPC_a) does not exceed 1/10, that is

$C_a / MPC_a \leq 1/10$

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ii. The sum of such ratios for all the radionuclides considered as not present in the mixture does not exceed 1/4; that is

$$C_a / MPC_a + C_b / MPC_b + \leq 1/4]$$

7:28-6.6 Dose equivalent to an embryo/fetus

(a) The State licensee or registrant shall ensure that the dose equivalent to the embryo/fetus during the entire pregnancy, due to the occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv). Recordkeeping shall meet the requirements set forth at N.J.A.C. 7:28-8.1.

(b) The State licensee or registrant shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in (a) above.

(c) The dose equivalent to the embryo/fetus is the sum of:

1. The deep-dose equivalent to the declared pregnant woman; and

2. The dose equivalent to the embryo/fetus resulting from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

(d) If the dose equivalent to the embryo/fetus is found to have exceeded 0.5 rem (5 mSv), or is within 0.05 rem (0.5 mSv) of this dose, by the time the woman declares the pregnancy to the State licensee or registrant, the State licensee or registrant shall be deemed to be in compliance with (a) above if the additional dose equivalent to the embryo/fetus does not exceed 0.05 rem (0.5 mSv) during the remainder of the pregnancy.

SUBCHAPTER 7. RADIATION SURVEYS AND PERSONNEL MONITORING

7:28-7.1 Surveys inside controlled areas

This is a courtesy copy of this rule proposal. The official version will be published in the May 17, 2004 New Jersey Register. Should there be any discrepancies between this text and the official version of the proposal, the official version will govern.

(a) The State licensee or registrant shall ensure that [C]controlled areas shall be surveyed by, or under the direction of, a qualified individual to determine if the installation is maintained and operations are conducted in compliance with this Chapter.

(b) The State licensee or registrant shall ensure that [R]radiation levels shall be determined with the use of suitable instruments and methods.

(c) The State licensee or registrant shall ensure that [S]surveys shall be made of the air for radioactive content when the average concentrations may exceed 1/4 the amount specified in Section 6.5(a) (Average concentrations) of this Chapter, Column B, or prorated values when more than one isotope is present.

(d) The State licensee or registrant shall ensure that [I]installations where unsealed radioactive materials are stored or used shall be periodically surveyed for contamination of surfaces. These surveys shall be conducted in a manner to insure that the levels of surface contamination are below those that could lead to exposures amounting to ten per cent of the limits specified in Section 6.1 (a), (d) (Exposure of individuals in controlled areas) of this Chapter.

(e) The State licensee or registrant shall ensure that [T]the record of a survey shall contain, but shall not be limited to the radiation levels, the time the radiation is produced, the workweek and the fraction of the workweek that any individual may be exposed to the radiation and when required, the radioactive air concentrations and surface contaminations.

(f) The State licensee or registrant shall ensure that [S]subsequent surveys shall be conducted at such times and as frequently as may be necessary to assure that the controlled areas and operations remain in compliance with this Chapter.

SUBCHAPTER 9. RADIOACTIVE CONTAMINATION CONTROL

7:28-9.4 Sealed source testing

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(a) Unless otherwise specified in a Federal agency license, or a State license, sealed sources except tritium and krypton, containing more than ten times [the exempt quantities of Section 3.6 (Table of exempt quantities) of this Chapter] the generally licensed quantities of Section 4.5(c) (Quantities generally licensed) of this Chapter, Column B shall be leak tested [than ten times the generally licensed quantities of Section 4.19 (Quantities generally licensed) of this Chapter, Column B or more] at intervals not longer than six months.

(b) (No change.)

SUBCHAPTER 10. LABELING, POSTING AND CONTROLS

7:28-10.9 [Labeling, posting and disposal q]Quantities of radioactive materials that require labeling and posting

(a) [Microcurie table is] The quantities of radioactive material subject to all labeling and posting regulations in atomic number order are as follows:

[Material	Microcuries
Ag^{105}	1
Ag^{111}	10
As^{76}	10
As^{77}	10
Au^{198}	10
Au^{199}	10
$Ba^{140} + La^{140}$	1
Be^{7}	50
C^{14}	50
Ca^{45}	10
$Cd^{109} + Ag^{109}$	10
$Ce^{144} + Pr^{144}$	1
Cl^{36}	1
Co^{60}	1
Cr^{51}	50
$Cs^{137} + Ba^{137}$	1
Cu^{64}	50

Eu^{154}	1
F^{18}	50
Fe^{55}	50
Fe^{59}	1
Ga^{72}	10
Ge^{71}	50
H^3(HTO or H^2O)	250
I^{131}	10
In^{114}	1
Ir^{192}	10
K^{42}	10
Kr^{85}	5
La^{140}	10
Mn^{52}	1
Mn^{56}	50
Mo^{99}	10
Na^{22}	10
Na^{24}	10
Nb^{95}	10
Ni^{59}	1
Ni^{63}	1
P^{32}	10
$Pd^{103} + Rh^{103}$	50
Pd^{109}	10
Pm^{147}	10
Po^{210}	0.1
Pr^{143}	10
Pu^{239}	1
Ra^{226}	0.1
Rb^{86}	10
Re^{186}	10
Rh^{105}	10
$Ru^{106} + Rh^{106}$	1
S^{35}	50
Sb^{124}	1
Sc^{46}	1
Sm^{153}	10
Sn^{113}	10
Sr^{89}	1
$Sr^{90} + Y^{90}$	0.1
Ta^{182}	10
Tc^{96}	1
Tc^{99}	1
Te^{127}	10
Te^{129}	1
Th (natural)	50

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Tl^{204}	50
Tritium (See H^3)	250
U (natural)	50
U^{233}	1
U^{234}-U^{235}	50
V^{48}	1
W^{185}	10
Y^{90}	1
Y^{91}	1
Zn^{65}	10
Unidentified radioactive materials or any of the above in unknown mixtures	0.1

_____]

OAL, the following is a new table to appear in boldface.

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*Quantities of Licensed or Registered Material Requiring Labeling
(In Atomic Number Order)

Radionuclide	Quantity (uCi)
Hydrogen-3	1,000
Beryllium-7	1,000
Beryllium-10	1
Carbon-11	1,000
Carbon-14	100
Fluorine-18	1,000
Sodium-22	10
Sodium-24	100
Magnesium-28	100
Aluminum-26	10
Silicon-31	1,000
Silicon-32	1
Phosphorus-32	10
Phosphorus-33	100
Sulfur-35	100
Chlorine-36	10
Chlorine-38	1,000
Chlorine-39	1,000
Argon-39	1,000
Argon-41	1,000
Potassium-40	100
Potassium-42	1,000
Potassium-43	1,000
Potassium-44	1,000
Potassium-45	1,000
Calcium-41	100
Calcium-45	100
Calcium-47	100
Scandium-43	1,000
Scandium-44m	100
Scandium-44	100
Scandium-46	10
Scandium-47	100
Scandium-48	100
Scandium-49	1,000
Titanium-44	1
Titanium-45	1,000
Vanadium-47	1,000
Vanadium-48	100
Vanadium-49	1,000

Chromium-48 ……...1,000
Chromium-49 ……..1,000
Chromium-51 ……...1,000
Manganese-51 ……...1,000
Manganese-52m ……...1,000
Manganese-52 ……..100
Manganese-53 ……...1,000
Manganese-54 ……..100
Manganese-56 ……...1,000
Iron-52……..100
Iron-55……..100
Iron-59……10
Iron-60……..1
Cobalt-55 ……..100
Cobalt-56 ……10
Cobalt-57 ……..100
Cobalt-58m ……...1,000
Cobalt-58 ……..100
Cobalt-60m ……....1,000
Cobalt-60 ……..…1
Cobalt-61 ……...1,000
Cobalt-62m ……...……1,000
Nickel-56 ……..100
Nickel-57 ……..100
Nickel-59 ……..100
Nickel-63 ……..100
Nickel-65 ……...1,000
Nickel-66 ……10
Copper-60 ……...1,000
Copper-61 ……...1,000
Copper-64 ……...1,000
Copper-67 ……...…1,000
Zinc-62 ……..100
Zinc-63 ……...1,000
Zinc-65 ……....10
Zinc-69m ……..100
Zinc-69 ……...1,000
Zinc-71m ……...1,000
Zinc-72 ……..100
Gallium-65 ……...1,000
Gallium-66 ……..100
Gallium-67 ……...1,000
Gallium-68 ……...……1,000
Gallium-70 ……..…..1,000
Gallium-72 ……...……100
Gallium-73 ……...1,000

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Germanium-66	1,000
Germanium-67	1,000
Germanium-68	10
Germanium-69	1,000
Germanium-71	1,000
Germanium-75	1,000
Germanium-77	1,000
Germanium-78	1,000
Arsenic-69	1,000
Arsenic-70	1,000
Arsenic-71	100
Arsenic-72	100
Arsenic-73	100
Arsenic-74	100
Arsenic-76	100
Arsenic-77	100
Arsenic-78	1,000
Selenium-70	1,000
Selenium-73m	1,000
Selenium-73	100
Selenium-75	100
Selenium-79	100
Selenium-81m	1,000
Selenium-81	1,000
Selenium-83	1,000
Bromine-74m	1,000
Bromine-74	1,000
Bromine-75	1,000
Bromine-76	100
Bromine-77	1,000
Bromine-80m	1,000
Bromine-80	1,000
Bromine-82	100
Bromine-83	1,000
Bromine-84	1,000
Krypton-74	1,000
Krypton-76	1,000
Krypton-77	1,000
Krypton-79	1,000
Krypton-81	1,000
Krypton-83m	1,000
Krypton-85m	1,000
Krypton-85	1,000
Krypton-87	1,000
Krypton-88	1,000
Rubidium-79	1,000

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Rubidium-81m ……...1,000
Rubidium-81 ……...1,000
Rubidium-82m ……...1,000
Rubidium-83 ……..100
Rubidium-84 ……..100
Rubidium-86 ……..100
Rubidium-87 ……..100
Rubidium-88 ……...…1,000
Rubidium-89 ……...…1,000
Strontium-80 ……...…100
Strontium-81 ……..…….1,000
Strontium-83 ……..…….100
Strontium-85m ……...…1,000
Strontium-85 ……..….100
Strontium-87m ……...……1,000
Strontium-89 ……..……..10
Strontium-90 ……..…….0.1
Strontium-91 ……...…100
Strontium-92 ……..…….100
Yttrium-86m ……..…..1,000
Yttrium-86 ……..…….100
Yttrium-87 ……..…….100
Yttrium-88 ……10
Yttrium-90m ……...…1,000
Yttrium-90 ……10
Yttrium-91m ……..……1,000
Yttrium-91 ……..……10
Yttrium-92 ……..100
Yttrium-93 ……100
Yttrium-94 ……..….1,000
Yttrium-95 ……..….1,000
Zirconium-86 ……100
Zirconium-88 ……...……10
Zirconium-89 ……..100
Zirconium-93 ……..1
Zirconium-95 ……10
Zirconium-97 ……..100
Niobium-88 ……...……1,000
Niobium-89m (66 min) ……...…1,000
Niobium-89 (122 min) ……...1,000
Niobium-90 ……..100
Niobium-93m ……...…….10
Niobium-94 ……..……1
Niobium-95m ……..100
Niobium-95 ……..100
Niobium-96 ……..…100

Niobium-97 ……..…1,000
Niobium-98 ……...1,000
Molybdenum-90 ……..100
Molybdenum-93m ……..…100
Molybdenum-93 ……....10
Molybdenum-99 ……..100
Molybdenum-101 ……..….1,000
Technetium-93m ……...1,000
Technetium-93 ……...1,000
Technetium-94m ……...…1,000
Technetium-94 ……...…1,000
Technetium-96m ……...……1,000
Technetium-96 ……..100
Technetium-97m ……..100
Technetium-97 ……..…..1,000
Technetium-98 ……10
Technetium-99m ……..…..1,000
Technetium-99 ……..100
Technetium-101 ……...…1,000
Technetium-104 ……...……1,000
Ruthenium-94 ……...….1,000
Ruthenium-97 ……...1,000
Ruthenium-103 ……..100
Ruthenium-105 ……..…..1,000
Ruthenium-106 ……..……1
Rhodium-99m ……..…….1,000
Rhodium-99 ……..100
Rhodium-100 ……..100
Rhodium-101m ……...…1,000
Rhodium-101 ……10
Rhodium-102m ……10
Rhodium-102 ……10
Rhodium-103m ……...……1,000
Rhodium-105 ……..100
Rhodium-106m ……..….1,000
Rhodium-107 ……..…….1,000
Palladium-100 ……..100
Palladium-101 ……...…1,000
Palladium-103 ……..100
Palladium-107 ……10
Palladium-109 ……100
Silver-102 ……...1,000
Silver-103 ……...1,000
Silver-104m ……...…1,000
Silver-104 ……...1,000
Silver-105 ……..100

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Silver-106m ……..100
Silver-106 ……..….1,000
Silver-108m ……..1
Silver-110m ……..…..10
Silver-111 ……..100
Silver-112 ……..100
Silver-115 ……...1,000
Cadmium-104 ……...1,000
Cadmium-107 ……...1,000
Cadmium-109 ……..…1
Cadmium-113m ……...…0.1
Cadmium-113 ……..100
Cadmium-115m ……10
Cadmium-115 ……..100
Cadmium-117m ……...1,000
Cadmium-117 ……...1,000
Indium-109 ……...1,000
Indium-110 (69.1 min.) ……...…1,000
Indium-110 (4.9 h) ……...…1,000
Indium-111 ……..…100
Indium-112 ……...1,000
Indium-113m ……...1,000
Indium-114m ……10
Indium-115m ……...1,000
Indium-115 ……..…100
Indium-116m ……...……1,000
Indium-117m ……...…1,000
Indium-117 ……...1,000
Indium-119m ……...1,000
Tin-110 ……..100
Tin-111 ……...1,000
Tin-113 ……..100
Tin-117m ……..100
Tin-119m ……..100
Tin-121m ……..100
Tin-121 ……...…1,000
Tin-123m ……...1,000
Tin-123 ……10
Tin-125 ……10
Tin-126 ……10
Tin-127 ……...……1,000
Tin-128 ……..…..1,000
Antimony-115 ……...…1,000
Antimony-116m ……...…1,000
Antimony-116 ……...1,000
Antimony-117 ……..….1,000

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Antimony-118m ……...1,000
Antimony-119 ……...1,000
Antimony-120 (16 min.) ……...……1,000
Antimony-120 (5.76 d) ……..……100
Antimony-122 ……..…100
Antimony-124m ……...1,000
Antimony-124 ……10
Antimony-125 ……..100
Antimony-126m ……...……1,000
Antimony-126 ……..100
Antimony-127 ……..……100
Antimony-128 (10.4 min.) ……...…1,000
Antimony-128 (9.01 h) ……..…100
Antimony-129 ……..…100
Antimony-130 ……...……1,000
Antimony-131 ……...…1,000
Tellurium-116 ……...1,000
Tellurium-121m ……10
Tellurium-121 ……..……100
Tellurium-123m ……..…..10
Tellurium-123 ……..100
Tellurium-125m ……10
Tellurium-127m ……10
Tellurium-127 ……...……1,000
Tellurium-129m ……10
Tellurium-129 ……...…1,000
Tellurium-131m ……10
Tellurium-131 ……..100
Tellurium-132 ……10
Tellurium-133m ……..…100
Tellurium-133 ……...1,000
Tellurium-134 ……...1,000
Iodine-120m ……...……1,000
Iodine-120 ……..……100
Iodine-121 ……...1,000
Iodine-123 ……..100
Iodine-124 ……....10
Iodine-125 ……..1
Iodine-126 ……..1
Iodine-128 ……..…..1,000
Iodine-129 ……..1
Iodine-130 ……10
Iodine-131 ……..……1
Iodine-132m ……..…100
Iodine-132 ……..…100
Iodine-133 ……10

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Iodine-134	1,000
Iodine-135	100
Xenon-120	1,000
Xenon-121	1,000
Xenon-122	1,000
Xenon-123	1,000
Xenon-125	1,000
Xenon-127	1,000
Xenon-129m	1,000
Xenon-131m	1,000
Xenon-133m	1,000
Xenon-133	1,000
Xenon-135m	1,000
Xenon-135	1,000
Xenon-138	1,000
Cesium-125	1,000
Cesium-127	1,000
Cesium-129	1,000
Cesium-130	1,000
Cesium-131	1,000
Cesium-132	100
Cesium-134m	1,000
Cesium-134	10
Cesium-135m	1,000
Cesium-135	100
Cesium-136	10
Cesium-137	10
Cesium-138	1,000
Barium-126	1,000
Barium-128	100
Barium-131m	1,000
Barium-131	100
Barium-133m	100
Barium-133	100
Barium-135m	100
Barium-139	1,000
Barium-140	100
Barium-141	1,000
Barium-142	1,000
Lanthanum-131	1,000
Lanthanum-132	100
Lanthanum-135	1,000
Lanthanum-137	10
Lanthanum-138	100
Lanthanum-140	100
Lanthanum-141	100

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Lanthanum-142 ……100
Cerium-137m ……100
Cerium-137 ……1,000
Cerium-139 ……100
Cerium-141 ……100
Cerium-143 ……100
Cerium-144 ……1
Praseodymium-136 ……1,000
Praseodymium-137 ……1,000
Praseodymium-138m ……1,000
Praseodymium-139 ……1,000
Praseodymium-142m ……1,000
Praseodymium-142 ……100
Praseodymium-143 ……100
Praseodymium-144 ……1,000
Praseodymium-145 ……100
Praseodymium-147 ……1,000
Neodymium-136 ……1,000
Neodymium-138 ……100
Neodymium-139m ……1,000
Neodymium-139 ……1,000
Neodymium-141 ……1,000
Neodymium-147 ……100
Neodymium-149 ……1,000
Neodymium-151 ……1,000
Promethium-141 ……1,000
Promethium-143 ……100
Promethium-144 ……10
Promethium-145 ……10
Promethium-146 ……1
Promethium-147 ……10
Promethium-148m ……10
Promethium-148 ……10
Promethium-149 ……100
Promethium-150 ……1,000
Promethium-151 ……100
Samarium-141m ……1,000
Samarium-141 ……1,000
Samarium-142 ……1,000
Samarium-145 ……100
Samarium-146 ……1
Samarium-147 ……100
Samarium-151 ……10
Samarium-153 ……100
Samarium-155 ……1,000
Samarium-156 ……1,000

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Europium-145 ……..100
Europium-146 ……..100
Europium-147 ……..…100
Europium-148 ……....10
Europium-149 ……..100
Europium-150 (12.62 h) ……..100
Europium-150 (34.2 y) ……..…1
Europium-152m ……..100
Europium-152 ……..…1
Europium-154 ……..1
Europium-155 ……....10
Europium-156 ……..100
Europium-157 ……..100
Europium-158 ……...…1,000
Gadolinium-145 ……...1,000
Gadolinium-146 ……....10
Gadolinium-147 ……..100
Gadolinium-148 ……...0.001
Gadolinium-149 ……..100
Gadolinium-151 ……10
Gadolinium-152 ……..100
Gadolinium-153 ……10
Gadolinium-159 ……..…100
Terbium-147 ……...…1,000
Terbium-149 ……..…100
Terbium-150 ……...……1,000
Terbium-151 ……..……100
Terbium-153 ……..…..1,000
Terbium-154 ……..100
Terbium-155 ……..…..1,000
Terbium-156m (5.0 h)……..…..1,000
Terbium-156m (24.4 h) ……..…..1,000
Terbium-156 ……..100
Terbium-157 ……10
Terbium-158 ……..1
Terbium-160 ……10
Terbium-161 ……..100
Dysprosium-155 ……...…1,000
Dysprosium-157 ……...1,000
Dysprosium-159 ……..100
Dysprosium-165 ……..….1,000
Dysprosium-166 ……...…100
Holmium-155 ……..….1,000
Holmium-157 ……..….1,000
Holmium-159 ……...1,000
Holmium-161 ……...1,000

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Holmium-162m ……...1,000
Holmium-162 ……...1,000
Holmium-164m ……...…1,000
Holmium-164 ……...1,000
Holmium-166m ……..…1
Holmium-166 ……..……100
Holmium-167 ……..….1,000
Erbium-161 ……...1,000
Erbium-165 ……...1,000
Erbium-169 ……..….100
Erbium-171 ……..….100
Erbium-172 ……..….100
Thulium-162 ……...1,000
Thulium-166 ……..100
Thulium-167 ……..100
Thulium-170 ……10
Thulium-171 ……10
Thulium-172 ……..100
Thulium-173 ……..……100
Thulium-175 ……...……1,000
Ytterbium-162……...….1,000
Ytterbium-166……...…100
Ytterbium-167……...1,000
Ytterbium-169……..….100
Ytterbium-175……...…100
Ytterbium-177……...1,000
Ytterbium-178……...…1,000
Lutetium-169 ……...…100
Lutetium-170 ……..100
Lutetium-171 ……..….100
Lutetium-172 ……..….100
Lutetium-173 ……10
Lutetium-174m ……10
Lutetium-174 ……10
Lutetium-176m ……...…1,000
Lutetium-176 ……..….100
Lutetium-177m ……10
Lutetium-177 ……..100
Lutetium-178m ……...……1,000
Lutetium-178 ……...….1,000
Lutetium-179 ……...….1,000
Hafnium-170 ……..….100
Hafnium-172 ……..…….1
Hafnium-173 ……...……1,000
Hafnium-175 ……..……100
Hafnium-177m ……...….1,000

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Hafnium-178m ……0.1
Hafnium-179m ……10
Hafnium-180m ……1,000
Hafnium-181 ……10
Hafnium-182m ……1,000
Hafnium-182 ……0.1
Hafnium-183 ……1,000
Hafnium-184 ……100
Tantalum-172 ……1,000
Tantalum-173 ……1,000
Tantalum-174 ……1,000
Tantalum-175 ……1,000
Tantalum-176 ……100
Tantalum-177 ……1,000
Tantalum-178 ……1,000
Tantalum-179 ……100
Tantalum-180m ……1,000
Tantalum-180 ……100
Tantalum-182m ……1,000
Tantalum-182 ……10
Tantalum-183 ……100
Tantalum-184 ……100
Tantalum-185 ……1,000
Tantalum-186 ……1,000
Tungsten-176 ……1,000
Tungsten-177 ……1,000
Tungsten-178 ……1,000
Tungsten-179 ……1,000
Tungsten-181 ……1,000
Tungsten-185 ……100
Tungsten-187 ……100
Tungsten-188 ……10
Rhenium-177 ……1,000
Rhenium-178 ……1,000
Rhenium-181 ……1,000
Rhenium-182 (12.7 h)……1,000
Rhenium-182 (64.0 h)……100
[2]Rhenium-183 ……100
Rhenium-184m ……10
Rhenium-184 ……100
Rhenium-186m ……10
Rhenium-186 ……100
Rhenium-187 ……1,000
Rhenium-188m ……1,000
Rhenium-188 ……100
Rhenium-189 ……100

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Osmium-180 ……...1,000
Osmium-181 ……...1,000
Osmium-182 ……..100
Osmium-185 ……..…100
Osmium-189m ……...1,000
Osmium-191m ……...1,000
Osmium-191 ……..100
Osmium-193 ……..100
Osmium-194 ……..1
Iridium-182 ……...…1,000
Iridium-184 ……...…1,000
Iridium-185 ……...….1,000
Iridium-186 ……..100
Iridium-187 ……..…….1,000
Iridium-188 ……..100
Iridium-189 ……...…100
Iridium-190m ……...….1,000
Iridium-190 ……..100
Iridium-192 (73.8 d) ……..1
Iridium-192m (1.4 min.) ……10
Iridium-194m ……....10
Iridium-194 ……..……100
Iridium-195m ……...1,000
Iridium-195 ……...…1,000
Platinum-186 ……...1,000
Platinum-188 ……..100
Platinum-189 ……...…1,000
Platinum-191 ……..100
Platinum-193m ……..100
Platinum-193 ……...…1,000
Platinum-195m ……...…100
Platinum-197m ……...1,000
Platinum-197 ……..100
Platinum-199 ……...……1,000
Platinum-200 ……..100
Gold-193 ……...….1,000
Gold-194 ……..100
Gold-195 ……10
Gold-198m ……..100
Gold-198 ……...…100
Gold-199 ……..100
Gold-200m ……..100
Gold-200 ……...1,000
Gold-201 ……...1,000
Mercury-193m ……..100
Mercury-193 ……...1,000

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Mercury-194 ……..1
Mercury-195m ……..100
Mercury-195 ……...…1,000
Mercury-197m ……..…100
Mercury-197 ……...…1,000
Mercury-199m ……...1,000
Mercury-203 ……..…100
Thallium-194m ……...1,000
Thallium-194 ……...…1,000
Thallium-195 ……...1,000
Thallium-197 ……..……1,000
Thallium-198m ……...…1,000
Thallium-198 ……..……1,000
Thallium-199 ……...…1,000
Thallium-200 ……...1,000
Thallium-201 ……...1,000
Thallium-202 ……..100
Thallium-204 ……..…100
Lead-195m ……...1,000
Lead-198 ……...1,000
Lead-199 ……...1,000
Lead-200 ……..100
Lead-201 ……...1,000
Lead-202m ……...…1,000
Lead-202 ……..…..10
Lead-203 ……...1,000
Lead-205 ……..…100
Lead-209 ……...1,000
Lead-210 ……..…0.01
Lead-211 ……..…100
Lead-212 ……..…1
Lead-214 ……..100
Bismuth-200 ……...…1,000
Bismuth-201 ……...1,000
Bismuth-202 ……...1,000
Bismuth-203 ……..100
Bismuth-205 ……..100
Bismuth-206 ……..100
Bismuth-207 ……....10
Bismuth-210m ……...0.1
Bismuth-210 ……..1
Bismuth-212 ……10
Bismuth-213 ……10
Bismuth-214 ……..100
Polonium-203 ……..……1,000
Polonium-205 ……...…1,000

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Polonium-207 ……...1,000
Polonium-210 ……...0.1
Astatine-207 ……..…100
Astatine-211 ……....10
Radon-220 ……..1
Radon-222 ……..…1
Francium-222 ……..…100
Francium-223 ……..100
Radium-223 ……..….0.1
Radium-224 ……...0.1
Radium-225 ……...0.1
Radium-226 ……...0.1
Radium-227 ……...…1,000
Radium-228 ……..….0.1
Actinium-224 ……..…1
Actinium-225 ……0.01
Actinium-226 ……...…0.1
Actinium-227 ……...0.001
Actinium-228 ……..……1
Thorium-226 ……10
Thorium-227 ……0.01
Thorium-228 ……..……0.001
Thorium-229 ……...…0.001
Thorium-230 ……...0.001
Thorium-231 ……..……100
[1]Thorium-232 ……...…100
Thorium-234 ……10
Thorium-natural ……..…100
Protactinium-227 ……...….10
Protactinium-228 ……..1
Protactinium-230 ……...……0.1
Protactinium-231 ……...0.001
Protactinium-232 ……..……1
Protactinium-233 ……..….100
Protactinium-234 ……..….100
Uranium-230 ……..…0.01
Uranium-231 ……..100
Uranium-232 ……...0.001
Uranium-233 ……...……0.001
[1]Uranium-234 ……...…0.001
[1]Uranium-235 ……...0.001
Uranium-236 ……...….0.001
Uranium-237 ……..100
[1]Uranium-238 ……..….100
Uranium-239 ……...….1,000
Uranium-240 ……..100

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Uranium-natural ……..100
Neptunium-232 ……..100
Neptunium-233 ……...1,000
Neptunium-234 ……..…100
Neptunium-235 ……..100
Neptunium-236 (1.15 x 10^5 y) ……...0.001
Neptunium-236 (22.5 h) ……..1
Neptunium-237 ……...……0.001
Neptunium-238 ……10
Neptunium-239 ……...…100
Neptunium-240 ……..….1,000
Plutonium-234 ……...….10
Plutonium-235 ……...…1,000
Plutonium-236 ……...……0.001
Plutonium-237 ……..……100
Plutonium-238 ……...……0.001
Plutonium-239 ……..….0.001
Plutonium-240 ……..….0.001
Plutonium-241 …….0.01
Plutonium-242 ……...…0.001
Plutonium-243 ……...……1,000
Plutonium-244 ……..….0.001
Plutonium-245 ……..100
Americium-237 ……...1,000
Americium-238 ……..100
Americium-239 ……...……1,000
Americium-240 ……..100
Americium-241 ……...……0.001
Americium-242m ……..…..0.001
Americium-242 ……10
Americium-243 ……...……0.001
Americium-244m ……..……100
Americium-244 ……...…….10
Americium-245 ……...1,000
Americium-246m ……...1,000
Americium-246 ……..…….1,000
Curium-238 ……..100
Curium-240 ……...0.1
Curium-241 ……..1
Curium-242 ……..……0.01
Curium-243 ……..…..0.001
Curium-244 ……...…0.001
Curium-245 ……...0.001
Curium-246 ……..…….0.001
Curium-247 ……..…..0.001
Curium-248 ……...…0.001

Curium-249 ……...1,000
Berkelium-245 ……..….100
Berkelium-246 ……..….100
Berkelium-247 ……...0.001
Berkelium-249 ……...0.1
Berkelium-250 ……...….10
Californium-244 ……..100
Californium-246 ……..….1
Californium-248 ……0.01
Californium-249 ……...……0.001
Californium-250 ……...…0.001
Californium-251 ……...0.001
Californium-252 ……..…..0.001
Californium-253 ……..……..0.1
Californium-254 ……..…..0.001
Einsteinium-250 ……..100
Einsteinium-251 ……..100
Einsteinium-253 ……...……0.1
Einsteinium-254m ……..……1
Einsteinium-254 ……0.01
Fermium-252 ……...…1
Fermium-253 ……..1
Fermium-254 ……10
Fermium-255 ……..1
Fermium-257 ……..…0.01
Mendelevium-257 ……10
Mendelevium-258 ……0.01

Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition 0.001

Any radionuclide other than alpha emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition 0.01

The quantities listed above were derived by taking 1/10th of the most restrictive ALI listed in table 1, columns 1 and 2, of appendix B to 10 CFR 20, rounding to the nearest factor of 10, and arbitrarily constraining the values listed between 0.001 and 1,000 _Ci. Values of 100 _Ci have been assigned for radionuclides having a radioactive half-life in excess of 10^9 years (except rhenium, 1,000 _Ci) to take into account their low specific activity.

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These quantities do not apply to source materials as defined by the NRC for thorium and uranium.

The value for Re-183 is actually taken from Re-186. The value for Re-183 could not be calculated due to the fact that Re-183 is not listed in 10 CFR 20, Appendix B.

(b) For purposes of Sections 10.5 (Areas containing radioactive material) and 10.6 (Labeling of equipment and containers) where there is involved a combination of [isotopes] radionuclides in known amounts, the limit for the combination shall be derived as follows: [by] determin[ing]e, for each [isotope] radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific [isotope] radionuclide when not in combination. The sum of such ratios for all [isotopes] radionuclides in the combination may not exceed ``1'' (i.e., ``unity'').

SUBCHAPTER 11. DISPOSAL OF RADIOACTIVE MATERIALS

7:28-11.2 Disposal by release into sanitary sewer systems

(a) [An owner may discharge radioactive material into a sanitary sewerage system providing:

1. It is readily soluble or dispersible in water;

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2. The quantity of any radioactive material released into the system by the owner in any one day does not exceed the larger of subparagraphs (i) of (ii) of this paragraph:

i. The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the owner, will result in an average concentration not greater than the limits specified in Section 6.5 (a) (Average concentrations) of this Chapter Column A, or prorated values if more than one isotope is released: or

ii. Ten times the quantity of such material specified in Section 10.9 (Labeling, posting and disposal quantities of radioactive materials) of this Chapter and

3. The quantity of any radioactive material released in any one month, if diluted by the average monthly quantity of sewage released by the owner, will not result in an average concentration exceeding the limits specified in Section 6.5 (a) (Average concentrations) of this Chapter Column A, or prorated values if more than one isotope is released; and

4. The gross quantity of radioactive material released into the sewerage system by the owner does not exceed one curie per year.] A State licensee or licensee may discharge State licensed or other radioactive material into a sanitary sewer system if each of the following conditions is satisfied:

1. The material is readily soluble (or is readily dispersible biological material) in water; and

2. The quantity of State licensed or other radioactive material that the State licensee releases into the sewer in 1 month divided by the average monthly volume of water released into the sewer by the State licensee does not exceed the concentration listed in the Appendix, Table 2 of this subchapter; and

3. If more than one radionuclide is released, the following conditions must also be satisfied:

i. The State licensee shall determine the fraction of the limit in the Appendix, Table 2 of this subchapter represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the State

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licensee into the sewer by the concentration of that radionuclide listed in the Appendix, Table 2 of this subchapter; and

ii. The sum of the fractions for each radionuclide required by (a)3i above does not exceed unity; and

4. The total quantity of State licensed and other radioactive material that the State licensee releases into the sanitary sewerage system in a year does not exceed 1 Curie (37 GBq).

(b) [Radioactive wastes excreted by humans shall be exempt from the limitations of subsection (a) of this Section.] Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in (a) above.

(c) Discharges into a sanitary sewer system from a State licensee for TENORM, other than from a water treatment facility, shall not exceed the concentrations listed in Table 1, Column 2 of the Appendix of this subchapter for all isotopes of uranium, thorium, radium and their progeny.

7:28-11.3 Disposal by discharges into the air, ground waters or surface waters

(a) A[n] State licensee or licensee [owner] may dispose of State-licensed or any other radioactive material into the air outside a controlled area provided the concentration at the point where the State-licensed material leaves the controlled area is not in excess of the concentrations specified in [Section 6.5(a) (Average Concentrations) of this Chapter, Column D,] the Appendix of this subchapter, Table 1, Column 1, or prorated values if more than one isotope is discharged. Where the State licensed material is discharged through a stack, tube pipe, or similar conduit, the determination may be made with respect to the point where the State licensed material leaves such a conduit. For purposes of this subsection, concentrations may be averaged over periods not greater than one year.

(b) No State licensee or licensee [owner]shall dispose of State-licensed or any other radioactive material into surface waters or into ground waters without specific, prior permission

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in writing, in the form of a New Jersey Pollutant Discharge Elimination System permit, from the Department.

OAL, the following is a new table to appear in boldface.

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Appendix

Concentrations for Effluent and Sanitary Sewer Releases

Atomic Number	Radionuclide	Class	Table 1 Effluent Concentrations Col. 1 Air (uCi/ml)	Col. 2 Water (uCi/ml)	Table 2 Releases to Sewers Monthly Ave. Concentration (uCi/ml)
1	Hydrogen-3	Water,	1E-7	1E-3	1E-2
4	Beryllium-7	W, all compounds except those given for Y	3E-8	6E-4	6E-3
		Y, oxides, halides, and nitrates	3E-8	------	------
4	Beryllium-10	W, see ^{7}Be	2E-10	------	------
		LLI wall	------	2E-5	2E-4
		Y, see ^{7}Be	2E-11	------	------
6	Carbon-11	Monoxide	2E-6	------	------
		Dioxide	9E-7	------	------
		Compounds	6E-7	6E-3	6E-2
6	Carbon-14	Monoxide	2E-6	------	------
		Dioxide	3E-7	------	------
		Compounds	3E-9	3E-5	3E-4
9	Fluorine-18	D, fluorides of H, Li, Na, K, Rb, Cs, and Fr	1E-7	------	------
		St wall	------	7E-4	7E-3
		W, fluorides of Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi, Fe, Ru, Os, Co, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, V, Nb, Ta, Mn, Tc, and Re	1E-7	------	------
		Y, lanthanum fluoride	1E-7	------	------
11	Sodium-22	D, all compounds	9E-10	6E-6	6E-5
11	Sodium-24	D, all compounds	7E-9	5E-5	5E-4
12	Magnesium-28	D, all compounds except those given for W	2E-9	9E-6	9E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	2E-9	------	------
13	Aluminum-26	D, all compounds except those given for W	9E-11	6E-6	6E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	1E-10	------	------
14	Silicon-31	D, all compounds except those given for W and Y	4E-8	1E-4	1E-3
		W, oxides, hydroxides, carbides, and nitrates	5E-8	------	------
		Y, aluminosilicate glass	4E-8	------	------

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Atomic Number	Radionuclide	Class	Table 1 Effluent Concentrations Col. 1 Air (uCi/ml)	Col. 2 Water (uCi/ml)	Table 2 Releases to Sewers Monthly Ave. Concentration (uCi/ml)
14	Silicon-32	D, see ^{31}Si	3E-10	------	------
		LLI wall (3E+3)	------	4E-5	4E-4
		W, see ^{31}Si	2E-10	------	------
		Y, see ^{31}Si	7E-12	------	------
15	Phosphorus-32	D, all compounds except phosphates given for W	1E-9	9E-6	9E-5
		W, phosphates of Zn^{2+}, S^{3+}, Mg^{2+}, Fe^{3+}, Bi^{3+}, and lanthanides	5E-10	------	------
15	Phosphorus-33	D, see ^{32}P	1E-8	8E-5	8E-4
		W, see ^{32}P	4E-9	------	------
16	Sulfur-35	Vapor	2E-8	------	------
		D, sulfides and sulfates except those given for W	2E-8	------	------
		LLI wall (8E+3)	------	1E-4	1E-3
		W, elemental sulfur, sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, W, and Mo. Sulfates of Ca, Sr, Ba, Ra, As, Sb, and Bi	3E-9	------	------
17	Chlorine-36	D, chlorides of H, Li, Na, K, Rb, Cs, and Fr	3E-9	2E-5	2E-4
		W, chlorides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re	3E-10	------	------
17	Chlorine-38	D, see ^{36}Cl	6E-8	------	------
		St wall	------	3E-4	3E-3
		W, see ^{36}Cl	6E-8	------	------
17	Chlorine-39	D, see ^{36}Cl	7E-8	------	------
		St wall	------	5E-4	5E-3
		W, see ^{36}Cl	8E-8	------	------
18	Argon-37	Submersion[a/]	6E-3	------	------
18	Argon-39	Submersion[a/]	8E-7	------	------
18	Argon-41	Submersion[a/]	1E-8	------	------
19	Potassium-40	D, all compounds	6E-10	4E-6	4E-5
19	Potassium-42	D, all compounds	7E-9	6E-5	6E-4
19	Potassium-43	D, all compounds	1E-8	9E-5	9E-4
19	Potassium-44	D, all compounds	9E-8	------	------
		St wall	------	5E-4	5E-3

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Atomic Number	Radionuclide	Class	Table 1 Effluent Concentrations Col. 1 Air (uCi/ml)	Col. 2 Water (uCi/ml)	Table 2 Releases to Sewers Monthly Ave. Concentration (uCi/ml)
19	Potassium-45	D, all compounds	2E-7	------	------
		St wall	------	7E-4	7E-3
20	Calcium-41	W, all compounds	------	------	------
		Bone surf	5E-9	6E-5	6E-4
20	Calcium-45	W, all compounds	1E-9	2E-5	2E-4
20	Calcium-47	W, all compounds	1E-9	1E-5	1E-4
21	Scandium-43	Y, all compounds	3E-8	1E-4	1E-3
21	Scandium-44m	Y, all compounds	1E-9	7E-6	7E-5
21	Scandium-44	Y, all compounds	2E-8	5E-5	5E-4
21	Scandium-46	Y, all compounds	3E-10	1E-5	1E-4
21	Scandium-47	Y, all compounds	4E-9	------	------
		LLI wall	------	4E-5	4E-4
21	Scandium-48	Y, all compounds	2E-9	1E-5	1E-4
21	Scandium-49	Y, all compounds	8E-8	3E-4	3E-3
22	Titanium-44	D, all compounds except those given for W and Y	2E-11	4E-6	4E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	4E-11	------	------
		Y, SrTi0	8E-12	------	------
22	Titanium-45	D, see ^{44}Ti	3E-8	1E-4	1E-3
		W, see ^{44}Ti	5E-8	------	------
		Y, see ^{44}Ti	4E-8	------	------
23	Vanadium-47	D, all compounds except those given for W	1E-7	------	------
		St wall	------	4E-4	4E-3
		W, oxides, hydroxides, carbides, and halides	1E-7	------	------
23	Vanadium-48	D, see ^{47}V	2E-9	9E-6	9E-5
		W, see ^{47}V	9E-10	------	------
23	Vanadium-49	D, see ^{47}V	------	------	------
		LLI wall/Bone surface	5E-8	1E-3	1E-2
		W, see ^{47}V	2E-8	------	------
24	Chromium-48	D, all compounds except those given for W and Y	2E-8	8E-5	8E-4
		W, halides and nitrates	1E-8	------	------
		Y, oxides and hydroxides	1E-8	------	------
24	Chromium-49	D, see ^{48}Cr	1E-7	4E-4	4E-3
		W, see ^{48}Cr	1E-7	------	------
		Y, see ^{48}Cr	1E-7	------	------
24	Chromium-51	D, see ^{48}Cr	6E-8	5E-4	5E-3
		W, see ^{48}Cr	3E-8	------	------
		Y, see ^{48}Cr	3E-8	------	------

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Atomic Number	Radionuclide	Class	Table 1 Effluent Concentrations Col. 1 Air (uCi/ml)	Table 1 Effluent Concentrations Col. 2 Water (uCi/ml)	Table 2 Releases to Sewers Monthly Ave. Concentration (uCi/ml)
25	Manganese-51	D, all compounds except those given for W	7E-8	3E-4	3E-3
		W, oxides, hydroxides, halides, and nitrates	8E-8	------	------
25	Manganese-52m	D, see ^{51}Mn	1E-7	------	------
		St wall	------	5E-4	5E-3
		W, see ^{51}Mn	1E-7	------	------
25	Manganese-52	D, see ^{51}Mn	2E-9	1E-5	1E-4
		W, see ^{51}Mn	1E-9	------	------
25	Manganese-53	D, see ^{51}Mn	------	7E-4	7E-3
		Bone surf	3E-8	------	------
		W, see ^{51}Mn	2E-8	------	------
25	Manganese-54	D, see ^{51}Mn	1E-9	3E-5	3E-4
		W, see ^{51}Mn	1E-9	------	------
25	Manganese-56	D, see ^{51}Mn	2E-8	7E-5	7E-4
		W, see ^{51}Mn	3E-8	------	------
26	Iron-52	D, all compounds except those given for W	4E-9	1E-5	1E-4
		W, oxides, hydroxides, and halides	3E-9	------	------
26	Iron-55	D, see ^{52}Fe	3E-9	1E-4	1E-3
		W, see ^{52}Fe	6E-9	------	------
26	Iron-59	D, see ^{52}Fe	5E-10	1E-5	1E-4
		W, see ^{52}Fe	7E-10	------	------
26	Iron-60	D, see ^{52}Fe	9E-12	4E-7	4E-6
		W, see ^{52}Fe	3E-11	------	------
27	Cobalt-55	W, all compounds except those given for Y	4E-9	2E-5	2E-4
		Y, oxides, hydroxides, halides, and nitrates	4E-9	------	------
27	Cobalt-56	W, see ^{55}Co	4E-10	6E-6	6E-5
		Y, see ^{55}Co	3E-10	------	------
27	Cobalt-57	W, see ^{55}Co	4E-9	6E-5	6E-4
		Y, see ^{55}Co	9E-10	-----	------
27	Cobalt-58m	W, see ^{55}Co	1E-7	8E-4	8E-3
		Y, see ^{55}Co	9E-8	------	------
27	Cobalt-58	W, see ^{55}Co	2E-9	2E-5	2E-4
		Y, see ^{55}Co	1E-9	------	------
27	Cobalt-60m	W, see ^{55}Co	6E-6	------	------
		St wall	------	2E-2	2E-1
		Y, see ^{55}Co	4E-6	------	------
27	Cobalt-60	W, see ^{55}Co	2E-10	3E-6	3E-5
		Y, see ^{55}Co	5E-11	------	------

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27	Cobalt-61	W, see ^{55}Co	9E-8	3E-4	3E-3
		Y, see ^{55}Co	8E-8	------	------
27	Cobalt-62m	W, see ^{55}Co	2E-7	------	------
		St wall	------	7E-4	7E-3
		Y, see ^{55}Co	2E-7	------	------
28	Nickel-56	D, all compounds except those given for W	3E-9	2E-5	2E-4
		W, oxides, hydroxides, and carbides	2E-9	------	------
		Vapor	2E-9	------	------
28	Nickel-57	D, see ^{56}Ni	7E-9	2E-5	2E-4
		W, see ^{56}Ni	4E-9	------	------
		Vapor	9E-9	------	------
28	Nickel-59	D, see ^{56}Ni	5E-9	3E-4	3E-3
		W, see ^{56}Ni	1E-8	------	------
		Vapor	3E-9	------	------
28	Nickel-63	D, see ^{56}Ni	2E-9	1E-4	1E-3
		W, see ^{56}Ni	4E-9	------	------
		Vapor	1E-9	------	------
28	Nickel-65	D, see ^{56}Ni	3E-8	1E-4	1E-3
		W, see ^{56}Ni	4E-8	------	------
		Vapor	2E-8	------	------
28	Nickel-66	D, see ^{56}Ni	2E-9	------	------
		LLI wall	------	6E-6	6E-5
		W, see ^{56}Ni	9E-10	------	------
		Vapor	4E-9	------	------
29	Copper-60	D, all compounds except those given for W and Y	1E-7	------	------
		St wall	------	4E-4	4E-3
		W, sulfides, halides, and nitrates	2E-7	------	------
		Y, oxides and hydroxides	1E-7	------	------
29	Copper-61	D, see ^{60}Cu	4E-8	2E-4	2E-3
		W, see ^{60}Cu	6E-8	------	------
		Y, see ^{60}Cu	5E-8	------	------
29	Copper-64	D, see ^{60}Cu	4E-8	2E-4	2E-3
		W, see ^{60}Cu	3E-8	------	------
		Y, see ^{60}Cu	3E-8	------	------
29	Copper-67	D, see ^{60}Cu	1E-8	6E-5	6E-4
		W, see ^{60}Cu	7E-9	------	------
		Y, see ^{60}Cu	6E-9	------	------
30	Zinc-62	Y, all compounds	4E-9	2E-5	2E-4
30	Zinc-63	Y, all compounds	9E-8	------	------
		St wall	------	3E-4	3E-3
30	Zinc-65	Y, all compounds	4E-10	5E-6	5E-5
30	Zinc-69m	Y, all compounds	1E-8	6E-5	6E-4

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30	Zinc-69	Y, all compounds	2E-7	8E-4	8E-3
30	Zinc-71m	Y, all compounds	2E-8	8E-5	8E-4
30	Zinc-72	Y, all compounds	2E-9	1E-5	1E-4
31	Gallium-65	D, all compounds except those given for W	2E-7	------	------
		St wall	------	9E-4	9E-3
		W, oxides, hydroxides, carbides, halides, and nitrates	3E-7	------	------
31	Gallium-66	D, see ^{65}Ga	5E-9	1E-5	1E-4
		W, see ^{65}Ga	4E-9	------	------
31	Gallium-67	D, see ^{65}Ga	2E-8	1E-4	1E-3
		W, see ^{65}Ga	1E-8	------	------
31	Gallium-68	D, see ^{65}Ga	6E-8	2E-4	2E-3
		W, see ^{65}Ga	7E-8	------	------
31	Gallium-70	D, see ^{65}Ga	2E-7	------	------
		St wall	—	1E-3	1E-2
		W, see ^{65}Ga	3E-7	------	------
31	Gallium-72	D, see ^{65}Ga	5E-9	2E-5	2E-4
		W, see ^{65}Ga	4E-9	------	------
31	Gallium-73	D, see ^{65}Ga	2E-8	7E-5	7E-4
		W, see ^{65}Ga	2E-8	------	------
32	Germanium-66	D, all compounds except those given for W	4E-8	3E-4	3E-3
		W, oxides, sulfides, and halides	3E-8	------	------
32	Germanium-67	D, see ^{66}Ge	1E-7	------	------
		St wall	------	6E-4	6E-3
		W, see ^{66}Ge	1E-7	------	------
32	Germanium-68	D, see ^{66}Ge	5E-9	6E-5	6E-4
		W, see ^{66}Ge	1E-10	------	------
32	Germanium-69	D, see ^{66}Ge	2E-8	2E-4	2E-3
		W, see ^{66}Ge	1E-8	------	------
32	Germanium-71	D, see ^{66}Ge	6E-7	7E-3	7E-2
		W, see ^{66}Ge	6E-8	------	------
32	Germanium-75	D, see ^{66}Ge	1E-7	------	------
		St wall	------	9E-4	9E-3
		W, see ^{66}Ge	1E-7	------	------
32	Germanium-77	D, see ^{66}Ge	1E-8	1E-4	1E-3
		W, see ^{66}Ge	8E-9	------	------
32	Germanium-78	D, see ^{66}Ge	3E-8	------	------
		St wall	------	3E-4	3E-3
		W, see ^{66}Ge	3E-8	------	------

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33	Arsenic-69	W, all compounds	2E-7	------	------
		St wall	------	6E-4	6E-3
33	Arsenic-70	W, all compounds	7E-8	2E-4	2E-3
33	Arsenic-71	W, all compounds	6E-9	5E-5	5E-4
33	Arsenic-72	W, all compounds	2E-9	1E-5	1E-4
33	Arsenic-73	W, all compounds	2E-9	1E-4	1E-3
33	Arsenic-74	W, all compounds	1E-9	2E-5	2E-4
33	Arsenic-76	W, all compounds	2E-9	1E-5	1E-4
33	Arsenic-77	W, all compounds	7E-9	------	------
		LLI wall	------	6E-5	6E-4
33	Arsenic-78	W, all compounds	3E-8	1E-4	1E-3
34	Selenium-70	D, all compounds except those given for W	5E-8	1E-4	1E-3
		W, oxides, hydroxides, carbides, and elemental Se	6E-8	------	------
34	Selenium-73m	D, see ^{70}Se	2E-7	4E-4	4E-3
		W, see ^{70}Se	2E-7	------	------
34	Selenium-73	D, see ^{70}Se	2E-8	4E-5	4E-4
		W, see ^{70}Se	2E-8	------	------
34	Selenium-75	D, see ^{70}Se	1E-9	7E-6	7E-5
		W, see ^{70}Se	8E-10	------	------
34	Selenium-79	D, see ^{70}Se	1E-9	8E-6	8E-5
		W, see ^{70}Se	8E-10	------	------
34	Selenium-81m	D, see ^{70}Se	9E-8	3E-4	3E-3
		W, see ^{70}Se	1E-7	------	------
34	Selenium-81	D, see ^{70}Se	3E-7	------	------
		St wall	------	1E-3	1E-2
		W, see ^{70}Se	3E-7	------	------
34	Selenium-83	D, see ^{70}Se	2E-7	4E-4	4E-3
		W, see ^{70}Se	2E-7	------	------
35	Bromine-74m	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	5E-8	------	------
		St wall	------	3E-4	3E-3
		W, bromides of lantha-nides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	6E-8	------	------

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35	Bromine-74	D, see ^{74m}Br	1E-7	------	------
		St wall	------	5E-4	5E-3
		W, see ^{74m}Br	1E-7	------	------
35	Bromine-75	D, see ^{74m}Br	7E-8	------	------
		St wall	------	5E-4	5E-3
		W, see ^{74m}Br	7E-8	------	------
35	Bromine-76	D, see ^{74m}Br	7E-9	5E-5	5E-4
		W, see ^{74m}Br	6E-9	------	------
35	Bromine-77	D, see ^{74m}Br	3E-8	2E-4	2E-3
		W, see ^{74m}Br	3E-8	------	------
35	Bromine-80m	D, see ^{74m}Br	2E-8	3E-4	3E-3
		W, see ^{74m}Br	2E-8	------	------
35	Bromine-80	D, see ^{74m}Br	3E-7	------	------
		St wall	------	1E-3	1E-2
		W, see ^{74m}Br	3E-7	------	------
35	Bromine-82	D, see ^{74m}Br	6E-9	4E-5	4E-4
		W, see ^{74m}Br	5E-9	------	------
35	Bromine-83	D, see ^{74m}Br	9E-8	------	------
		St wall	------	9E-4	9E-3
		W, see ^{74m}Br	9E-8	------	------
35	Bromine-84	D, see ^{74m}Br	8E-8	------	------
		St wall	------	4E-4	4E-3
		W, see ^{74m}Br	9E-8	------	------
36	Krypton-74	Submersion[a/]	1E-8	------	------
36	Krypton-76	Submersion[a/]	4E-8	------	------
36	Krypton-77	Submersion[a/]	2E-8	------	------
36	Krypton-79	Submersion[a/]	7E-8	------	------
36	Krypton-81	Submersion[a/]	3E-6	------	------
36	Krypton-83m	Submersion[a/]	5E-5	------	------
36	Krypton-85m	Submersion[a/]	1E-7	------	------
36	Krypton-85	Submersion[a/]	7E-7	------	------
36	Krypton-87	Submersion[a/]	2E-8	------	------
36	Krypton-88	Submersion[a/]	9E-9	------	------
37	Rubidium-79	D, all compounds	2E-7	------	------
		St wall	------	8E-4	8E-3
37	Rubidium-81m	D, all compounds	5E-7	------	------
		St wall	------	4E-3	4E-2
37	Rubidium-81	D, all compounds	7E-8	5E-4	5E-3

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37	Rubidium-82m	D, all compounds	2E-8	2E-4	2E-3
37	Rubidium-83	D, all compounds	1E-9	9E-6	9E-5
37	Rubidium-84	D, all compounds	1E-9	7E-6	7E-5
37	Rubidium-86	D, all compounds	1E-9	7E-6	7E-5
37	Rubidium-87	D, all compounds	2E-9	1E-5	1E-4
37	Rubidium-88	D, all compounds	9E-8	------	------
		St wall	------	4E-4	4E-3
37	Rubidium-89	D, all compounds	2E-7	------	------
		St wall	------	9E-4	9E-3
38	Strontium-80	D, all soluble compounds except $SrTiO_3$	2E-8	6E-5	6E-4
		Y, all insoluble compounds and $SrTi0_3$	2E-8	------	------
38	Strontium-81	D, see ^{80}Sr	1E-7	3E-4	3E-3
		Y, see ^{80}Sr	1E-7	------	------
38	Strontium-82	D, see ^{80}Sr	6E-10	------	------
		LLI wall	------	3E-6	3E-5
		Y, see ^{80}Sr	1E-10	------	------
38	Strontium-83	D, see ^{80}Sr	1E-8	3E-5	3E-4
		Y, see ^{80}Sr	5E-9	------	------
38	Strontium-85m	D, see ^{80}Sr	9E-7	3E-3	3E-2
		Y, see ^{80}Sr	1E-6	------	------
38	Strontium-85	D, see ^{80}Sr	4E-9	4E-5	4E-4
		Y, see ^{80}Sr	2E-9	------	------
38	Strontium-87m	D, see ^{80}Sr	2E-7	6E-4	6E-3
		Y, see ^{80}Sr	2E-7	------	------
38	Strontium-89	D, see ^{80}Sr	1E-9	------	------
		LLI wall	------	8E-6	8E-5
		Y, see ^{80}Sr	2E-10	------	------
38	Strontium-90	D, see ^{80}Sr	------	------	------
		Bone surf	3E-11	5E-7	5E-6
		Y, see ^{80}Sr	6E-12	------	------
38	Strontium-91	D, see ^{80}Sr	8E-9	2E-5	2E-4
		Y, see ^{80}Sr	5E-9	------	------
38	Strontium-92	D, see ^{80}Sr	1E-8	4E-5	4E-4
		Y, see ^{80}Sr	9E-9	------	------
39	Yttrium-86m	W, all compounds except those given for Y	8E-8	3E-4	3E-3
		Y, oxides and hydroxides	8E-8	------	------
39	Yttrium-86	W, see ^{86m}Y	5E-9	2E-5	2E-4
		Y, see ^{86m}Y	5E-9	------	------

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39	Yttrium-87	W, see ^{86m}Y	5E-9	3E-5	3E-4
		Y, see ^{86m}Y	5E-9	------	------
39	Yttrium-88	W, see ^{86m}Y	3E-10	1E-5	1E-4
		Y, see ^{86m}Y	3E-10	------	------
39	Yttrium-90m	W, see ^{86m}Y	2E-8	1E-4	1E-3
		Y, see ^{86m}Y	2E-8	------	------
39	Yttrium-90	W, see ^{86m}Y	9E-10	------	------
		LLI wall	------	7E-6	7E-5
		Y, see ^{86m}Y	9E-10	------	------
39	Yttrium-91m	W, see ^{86m}Y	3E-7	2E-3	2E-2
		Y, see ^{86m}Y	2E-7	------	------
39	Yttrium-91	W, see ^{86m}Y	2E-10	------	------
		LLI wall	------	8E-6	8E-5
		Y, see ^{86m}Y	2E-10	------	------
39	Yttrium-92	W, see ^{86m}Y	1E-8	4E-5	4E-4
		Y, see ^{86m}Y	1E-8	------	------
39	Yttrium-93	W, see ^{86m}Y	4E-9	2E-5	2E-4
		Y, see ^{86m}Y	3E-9	------	------
39	Yttrium-94	W, see ^{86m}Y	1E-7	------	------
		St wall	------	4E-4	4E-3
		Y, see ^{86m}Y	1E-7	------	------
39	Yttrium-95	W, see ^{86m}Y	2E-7	------	------
		St wall	------	7E-4	7E-3
		Y, see ^{86m}Y	2E-7	------	------
40	Zirconium-86	D, all compounds except those given for W and Y	6E-9	2E-5	2E-4
		W, oxides, hydroxides, halides, and nitrates	4E-9	------	------
		Y, carbide	3E-9	------	------
40	Zirconium-88	D, see ^{86}Zr	3E-10	5E-5	5E-4
		W, see ^{86}Zr	7E-10	------	------
		Y, see ^{86}Zr	4E-10	------	------
40	Zirconium-89	D, see ^{86}Zr	5E-9	2E-5	2E-4
		W, see ^{86}Zr	3E-9	------	------
		Y, see ^{86}Zr	3E-9	------	------
40	Zirconium-93	D, see ^{86}Zr	------	------	------
		Bone surf	2E-11	4E-5	4E-4
		W, see ^{86}Zr	------	------	------
		Bone surf	9E-11	------	------
		Y, see ^{86}Zr	------	------	------
		Bone surf	9E-11	------	------
40	Zirconium-95	D, see ^{86}Zr	------	2E-5	2E-4
		Bone surf	4E-10	------	------
		W, see ^{86}Zr	5E-10	------	------
		Y, see ^{86}Zr	4E-10	------	------

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40	Zirconium-97	D, see ^{86}Zr	3E-9	9E-6	9E-5
		W, see ^{86}Zr	2E-9	------	------
		Y, see ^{86}Zr	2E-9	------	------
41	Niobium-88	W, all compounds except those given for Y	3E-7	------	------
		St wall	------	1E-3	1E-2
		Y, oxides and hydroxides	3E-7	------	------
41	Niobium-89 (66 min)	W, see ^{88}Nb	6E-8	1E-4	1E-3
		Y, see ^{88}Nb	5E-8	------	------
41	Niobium-89m (122 min)	W, see ^{88}Nb	3E-8	7E-5	7E-4
		Y, see ^{88}Nb	2E-8	------	------
41	Niobium-90	W, see ^{88}Nb	4E-9	1E-5	1E-4
		Y, see ^{88}Nb	3E-9	------	------
41	Niobium-93m	W, see ^{88}Nb	3E-9	------	------
		LLI wall	------	2E-4	2E-3
		Y, see ^{88}Nb	2E-10	------	------
41	Niobium-94	W, see ^{88}Nb	3E-10	1E-5	1E-4
		Y, see ^{88}Nb	2E-11	------	------
41	Niobium-95m	W, see ^{88}Nb	4E-9	------	------
		LLI wall	------	3E-5	3E-4
		Y, see ^{88}Nb	3E-9	------	------
41	Niobium-95	W, see ^{88}Nb	2E-9	3E-5	3E-4
		Y, see ^{88}Nb	2E-9	------	------
41	Niobium-96	W, see ^{88}Nb	4E-9	2E-5	2E-4
		Y, see ^{88}Nb	3E-9	------	------
41	Niobium-97	W, see ^{88}Nb	1E-7	3E-4	3E-3
		Y, see ^{88}Nb	1E-7	------	------
41	Niobium-98	W, see ^{88}Nb	8E-8	2E-4	2E-3
		Y, see ^{88}Nb	7E-8	------	------
42	Molybdenum-90	D, all compounds except those given for Y	1E-8	3E-5	3E-4
		Y, oxides, hydroxides, and MoS_2	6E-9	------	------
42	Molybdenum-93m	D, see ^{90}Mo	2E-8	6E-5	6E-4
		Y, see ^{90}Mo	2E-8	------	------
42	Molybdenum-93	D, see ^{90}Mo	8E-9	5E-5	5E-4
		Y, see ^{90}Mo	2E-10	------	------
42	Molybdenum-99	D, see ^{90}Mo	4E-9	------	------
		LLI wall	------	2E-5	2E-4
		Y, see ^{90}Mo	2E-9	------	------
42	Molybdenum-101	D, see ^{90}Mo	2E-7	------	------
		St wall	------	7E-4	7E-3
		Y, see ^{90}Mo	2E-7	------	------

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43	Technetium-93m	D, all compounds except those given for W	2E-7	1E-3	1E-2
		W, oxides, hydroxides, halides, and nitrates	4E-7	------	------
43	Technetium-93	D, see ^{93m}Tc	1E-7	4E-4	4E-3
		W, see ^{93m}Tc	1E-7	------	------
43	Technetium-94m	D, see ^{93m}Tc	6E-8	3E-4	3E-3
		W, see ^{93m}Tc	8E-8	------	------
43	Technetium-94	D, see ^{93m}Tc	3E-8	1E-4	1E-3
		W, see ^{93m}Tc	3E-8	------	------
43	Technetium-95m	D, see ^{93m}Tc	8E-9	5E-5	5E-4
		W, see ^{93m}Tc	3E-9	------	------
43	Technetium-95	D, see ^{93m}Tc	3E-8	1E-4	1E-3
		W, see ^{93m}Tc	3E-8	------	------
43	Technetium-96m	D, see ^{93m}Tc	4E-7	2E-3	2E-2
		W, see ^{93m}Tc	3E-7	------	------
43	Technetium-96	D, see ^{93m}Tc	5E-9	3E-5	3E-4
		W, see ^{93m}Tc	3E-9	------	------
43	Technetium-97m	D, see ^{93m}Tc	------	6E-5	6E-4
		St wall	1E-8	------	------
		W, see ^{93m}Tc	2E-9	------	------
43	Technetium-97	D, see ^{93m}Tc	7E-8	5E-4	5E-3
		W, see ^{93m}Tc	8E-9	------	------
43	Technetium-98	D, see ^{93m}Tc	2E-9	1E-5	1E-4
		W, see ^{93m}Tc	4E-10	------	------
43	Technetium-99m	D, see ^{93m}Tc	2E-7	1E-3	1E-2
		W, see ^{93m}Tc	3E-7	------	------
43	Technetium-99	D, see ^{93m}Tc	------	6E-5	6E-4
		St wall	8E-9	------	------
		W, see ^{93m}Tc	9E-10	------	------
43	Technetium-101	D, see ^{93m}Tc	5E-7	------	------
		St wall	------	2E-3	2E-2
		W, see ^{93m}Tc	5E-7	------	------
43	Technetium-104	D, see ^{93m}Tc	1E-7	------	------
		St wall	------	4E-4	4E-3
		W, see ^{93m}Tc	1E-7	------	------
44	Ruthenium-94	D, all compounds except those given for W and Y	6E-8	2E-4	2E-3
		W, halides	9E-8	------	------
		Y, oxides and hydroxides	8E-8	------	------
44	Ruthenium-97	D, see ^{94}Ru	3E-8	1E-4	1E-3
		W, see ^{94}Ru	2E-8	------	------
		Y, see ^{94}Ru	2E-8	------	------

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44	Ruthenium-103	D, see ^{94}Ru	2E-9	3E-5	3E-4
		W, see ^{94}Ru	1E-9	------	------
		Y, see ^{94}Ru	9E-10	------	------
44	Ruthenium-105	D, see ^{94}Ru	2E-8	7E-5	7E-4
		W, see ^{94}Ru	2E-8	------	------
		Y, see ^{94}Ru	2E-8	------	------
44	Ruthenium-106	D, see ^{94}Ru	1E-10	------	------
		LLI wall	------	3E-6	3E-5
		W, see ^{94}Ru	8E-11	------	------
		Y, see ^{94}Ru	2E-11	------	------
45	Rhodium-99m	D, all compounds except those given for W and Y	8E-8	2E-4	2E-3
		W, halides	1E-7	------	------
		Y, oxides and hydroxides	9E-8	------	------
45	Rhodium-99	D, see ^{99m}Rh	4E-9	3E-5	3E-4
		W, see ^{99m}Rh	3E-9	------	------
		Y, see ^{99m}Rh	3E-9	------	------
45	Rhodium-100	D, see ^{99m}Rh	7E-9	2E-5	2E-4
		W, see ^{99m}Rh	6E-9	------	------
		Y, see ^{99m}Rh	5E-9	------	------
45	Rhodium-101m	D, see ^{99m}Rh	2E-8	8E-5	8E-4
		W, see ^{99m}Rh	1E-8	------	------
		Y, see ^{99m}Rh	1E-8	------	------
45	Rhodium-101	D, see ^{99m}Rh	7E-10	3E-5	3E-4
		W, see ^{99m}Rh	1E-9	------	------
		Y, see ^{99m}Rh	2E-10	------	------
45	Rhodium-102m	D, see ^{99m}Rh	7E-10	------	------
		LLI wall	------	2E-5	2E-4
		W, see ^{99m}Rh	5E-10	------	------
		Y, see ^{99m}Rh	2E-10	------	------
45	Rhodium-102	D, see ^{99m}Rh	1E-10	8E-6	8E-5
		W, see ^{99m}Rh	2E-10	------	------
		Y, see ^{99m}Rh	8E-11	------	------
45	Rhodium-103m	D, see ^{99m}Rh	2E-6	6E-3	6E-2
		W, see ^{99m}Rh	2E-6	------	------
		Y, see ^{99m}Rh	2E-6	------	------
45	Rhodium-105	D, see ^{99m}Rh	2E-8	------	------
		LLI wall	------	5E-5	5E-4
		W, see ^{99m}Rh	9E-9	------	------
		Y, see ^{99m}Rh	8E-9	------	------
45	Rhodium-106m	D, see ^{99m}Rh	4E-8	1E-4	1E-3
		W, see ^{99m}Rh	5E-8	------	------
		Y, see ^{99m}Rh	5E-8	------	------
45	Rhodium-107	D, see ^{99m}Rh	3E-7	------	------
		St wall	------	1E-3	1E-2
		W, see ^{99m}Rh	4E-7	------	------
		Y, see ^{99m}Rh	3E-7	------	------

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46	Palladium-100	D, all compounds except those given for W and Y	2E-9	2E-5	2E-4
		W, nitrates	2E-9	------	------
		Y, oxides and hydroxides	2E-9	------	------
46	Palladium-101	D, see ^{100}Pd	5E-8	2E-4	2E-3
		W, see ^{100}Pd	5E-8	------	------
		Y, see ^{100}Pd	4E-8	------	------
46	Palladium-103	D, see ^{100}Pd	9E-9	------	------
		LLI wall	------	1E-4	1E-3
		W, see ^{100}Pd	6E-9	------	------
		Y, see ^{100}Pd	5E-9	------	------
46	Palladium-107	D, see ^{100}Pd	------	------	------
		LLI wall	3E-8	5E-4	5E-3
		W, see ^{100}Pd	1E-8	------	------
		Y, see ^{100}Pd	6E-10	------	------
46	Palladium-109	D, see ^{100}Pd	9E-9	3E-5	3E-4
		W, see ^{100}Pd	8E-9	------	------
		Y, see ^{100}Pd	6E-9	------	------
47	Silver-102	D, all compounds except those given for W and Y	2E-7	------	------
		St wall	------	9E-4	9E-3
		W, nitrates and sulfides	3E-7	------	------
		Y, oxides and hydroxides	3E-7	------	------
47	Silver-103	D, see ^{102}Ag	1E-7	5E-4	5E-3
		W, see ^{102}Ag	2E-7	------	------
		Y, see ^{102}Ag	2E-7	------	------
47	Silver-104m	D, see ^{102}Ag	1E-7	4E-4	4E-3
		W, see ^{102}Ag	2E-7	------	------
		Y, see ^{102}Ag	2E-7	------	------
47	Silver-104	D, see ^{102}Ag	1E-7	3E-4	3E-3
		W, see ^{102}Ag	2E-7	------	------
		Y, see ^{102}Ag	2E-7	------	------
47	Silver-105	D, see ^{102}Ag	1E-9	4E-5	4E-4
		W, see ^{102}Ag	2E-9	------	------
		Y, see ^{102}Ag	2E-9	------	------
47	Silver-106m	D, see ^{102}Ag	1E-9	1E-5	------
		W, see ^{102}Ag	1E-9	------	------
		Y, see ^{102}Ag	1E-9	------	------
47	Silver-106	D, see ^{102}Ag	3E-7	------	------
		St wall	------	9E-4	9E-3
		W, see ^{102}Ag	3E-7	------	------
		Y, see ^{102}Ag	3E-7	------	------
47	Silver-108m	D, see ^{102}Ag	3E-10	9E-6	9E-5
		W, see ^{102}Ag	4E-10	------	------
		Y, see ^{102}Ag	3E-11	------	------
47	Silver-110m	D, see ^{102}Ag	2E-10	6E-6	6E-5
		W, see ^{102}Ag	3E-10	------	------
		Y, see ^{102}Ag	1E-10	------	------

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47	Silver-111	D, see ^{102}Ag	------	------	------
		LLI wall	2E-9	2E-5	2E-4
		W, see ^{102}Ag	1E-9	------	------
		Y, see ^{102}Ag	1E-9	------	------
47	Silver-112	D, see ^{102}Ag	1E-8	4E-5	4E-4
		W, see ^{102}Ag	1E-8	------	------
		Y, see ^{102}Ag	1E-8	------	------
47	Silver-115	D, see ^{102}Ag	1E-7	------	------
		St wall	------	4E-4	4E-3
		W, see ^{102}Ag	1E-7	------	------
		Y, see ^{102}Ag	1E-7	------	------
48	Cadmium-104	D, all compounds except those given for W and Y	9E-8	3E-4	3E-3
		W, sulfides, halides, and nitrates	2E-7	------	------
		Y, oxides and hydroxides	2E-7	------	------
48	Cadmium-107	D, see ^{104}Cd	8E-8	3E-4	3E-3
		W, see ^{104}Cd	8E-8	------	------
		Y, see ^{104}Cd	7E-8	------	------
48	Cadmium-109	D, see ^{104}Cd	------	------	------
		Kidneys	7E-11	6E-6	6E-5
		W, see ^{104}Cd	------	------	------
		Kidneys	2E-10	------	------
		Y, see ^{104}Cd	2E-10	------	------
48	Cadmium-113m	D, see ^{104}Cd	------	------	------
		Kidneys	5E-12	5E-7	5E-6
		W, see ^{104}Cd	------	------	------
		Kidneys	2E-11	------	------
		Y, see ^{104}Cd	2E-11	------	------
48	Cadmium-113	D, see ^{104}Cd	------	------	------
		Kidneys	5E-12	4E-7	4E-6
		W, see ^{104}Cd	------	------	------
		Kidneys	2E-11	------	------
		Y, see ^{104}Cd	2E-11	------	------
48	Cadmium-115m	D, see ^{104}Cd	------	4E-6	4E-5
		Kidneys	1E-10	------	------
		W, see ^{104}Cd	2E-10	------	------
		Y, see ^{104}Cd	2E-10	------	------
48	Cadmium-115	D, see ^{104}Cd	2E-9	------	------
		LLI wall	------	1E-5	1E-4
		W, see ^{104}Cd	2E-9	------	------
		Y, see ^{104}Cd	2E-9	------	------
48	Cadmium-117m	D, see ^{104}Cd	2E-8	6E-5	6E-4
		W, see ^{104}Cd	2E-8	------	------
		Y, see ^{104}Cd	2E-8	------	------
48	Cadmium-117	D, see ^{104}Cd	2E-8	6E-5	6E-4
		W, see ^{104}Cd	2E-8	------	------
		Y, see ^{104}Cd	2E-8	------	------

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49	Indium-109	D, all compounds except those given for W	6E-8	3E-4	3E-3
		W, oxides, hydroxides, halides, and nitrates	9E-8	------	------
49	Indium-110 (69.1 min)	D, see ^{109}In	6E-8	2E-4	2E-3
		W, see ^{109}In	8E-8	------	------
49	Indium-110 (4.9 h)	D, see ^{109}In	2E-8	7E-5	7E-4
		W, see ^{109}In	3E-8	------	------
49	Indium-111	D, see ^{109}In	9E-9	6E-5	6E-4
		W, see ^{109}In	9E-9	------	------
49	Indium-112	D, see ^{109}In	9E-7	2E-3	2E-2
		W, see ^{109}In	1E-6	------	-----
49	Indium-113m	D, see ^{109}In	2E-7	7E-4	7E-3
		W, see ^{109}In	3E-7	------	------
49	Indium-114m	D, see ^{109}In	9E-11	------	------
		LLI wall	------	5E-6	5E-5
		W, see ^{109}In	1E-10	------	------
49	Indium-115m	D, see ^{109}In	6E-8	2E-4	2E-3
		W, see ^{109}In	7E-8	------	------
49	Indium-115	D, see ^{109}In	2E-12	5E-7	5E-6
		W, see ^{109}In	8E-12	------	------
49	Indium-116m	D, see ^{109}In	1E-7	3E-4	3E-3
		W, see ^{109}In	2E-7	------	------
49	Indium-117m	D, see ^{109}In	5E-8	2E-4	2E-3
		W, see ^{109}In	6E-8	------	------
49	Indium-117	D, see ^{109}In	2E-7	8E-4	8E-3
		W, see ^{109}In	3E-7	------	------
49	Indium-119m	D, see ^{109}In	2E-7	------	------
		St wall	------	7E-4	7E-3
		W, see ^{109}In	2E-7	------	------
50	Tin-110	D, all compounds except those given for W	2E-8	5E-5	5E-4
		W, sulfides, oxides, hydroxides, halides, nitrates, and stannic phosphate	2E-8	------	------
50	Tin-111	D, see ^{110}Sn	3E-7	1E-3	1E-2
		W, see ^{110}Sn	4E-7	------	------
50	Tin-113	D, see ^{110}Sn	2E-9	------	------
		LLI wall	------	3E-5	3E-4
		W, see ^{110}Sn	8E-10	------	------
50	Tin-117m	D, see ^{110}Sn	------	------	------
		LLI wall	3E-9	3E-5	3E-4
		W, see ^{110}Sn	2E-9	------	------

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50	Tin-119m	D, see ^{110}Sn	3E-9	------	------
		LLI wall	------	6E-5	6E-4
		W, see ^{110}Sn	1E-9	------	------
50	Tin-121m	D, see ^{110}Sn	1E-9	------	------
		LLI wall	------	5E-5	5E-4
		W, see ^{110}Sn	8E-10	------	------
50	Tin-121	D, see ^{110}Sn	2E-8	------	------
		LLI wall	------	8E-5	8E-4
		W, see ^{110}Sn	2E-8	------	------
50	Tin-123m	D, see ^{110}Sn	2E-7	7E-4	7E-3
		W, see ^{110}Sn	2E-7	------	------
50	Tin-123	D, see ^{110}Sn	9E-10	------	------
		LLI wall	------	9E-6	9E-5
		W, see ^{110}Sn	2E-10	------	------
50	Tin-125	D, see ^{110}Sn	1E-9	------	------
		LLI wall	------	6E-6	6E-5
		W, see ^{110}Sn	5E-10	------	------
50	Tin-126	D, see ^{110}Sn	8E-11	4E-6	4E-5
		W, see ^{110}Sn	9E-11	------	------
50	Tin-127	D, see ^{110}Sn	3E-8	9E-5	9E-4
		W, see ^{110}Sn	3E-8	------	------
50	Tin-128	D, see ^{110}Sn	4E-8	1E-4	1E-3
		W, see ^{110}Sn	5E-8	------	------
51	Antimony-115	D, all compounds except those given for W	3E-7	1E-3	1E-2
		W, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	4E-7	------	------
51	Antimony-116m	D, see ^{115}Sb	1E-7	3E-4	3E-3
		W, see ^{115}Sb	2E-7	------	------
51	Antimony-116	D, see ^{115}Sb	4E-7	------	------
		St wall	------	1E-3	1E-2
		W, see ^{115}Sb	5E-7	------	------
51	Antimony-117	D, see ^{115}Sb	3E-7	9E-4	9E-3
		W, see ^{115}Sb	4E-7	------	------
51	Antimony-118m	D, see ^{115}Sb	3E-8	7E-5	7E-4
		W, see ^{115}Sb	3E-8	------	------
51	Antimony-119	D, see ^{115}Sb	6E-8	2E-4	2E-3
		W, see ^{115}Sb	4E-8	------	------
51	Antimony-120 (16 min)	D, see ^{115}Sb	6E-7	------	------
		St wall	------	2E-3	2E-2
		W, see ^{115}Sb	7E-7	------	------
51	Antimony-120 (5.76 d)	D, see ^{115}Sb	3E-9	1E-5	1E-4
		W, see ^{115}Sb	2E-9	------	------

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51	Antimony-122	D, see ^{115}Sb	3E-9	------	------
		LLI wall	------	1E-5	1E-4
		W, see ^{115}Sb	2E-9	------	------
51	Antimony-124m	D, see ^{115}Sb	1E-6	3E-3	3E-2
		W, see ^{115}Sb	8E-7	------	------
51	Antimony-124	D, see ^{115}Sb	1E-9	7E-6	7E-5
		W, see ^{115}Sb	3E-10	------	------
51	Antimony-125	D, see ^{115}Sb	3E-9	3E-5	3E-4
		W, see ^{115}Sb	7E-10	------	------
51	Antimony-126m	D, see ^{115}Sb	3E-7	------	------
		St wall	------	9E-4	9E-3
		W, see ^{115}Sb	3E-7	------	------
51	Antimony-126	D, see ^{115}Sb	2E-9	7E-6	7E-5
		W, see ^{115}Sb	7E-10	------	------
51	Antimony-127	D, see ^{115}Sb	3E-9	------	------
		LLI wall	------	1E-5	1E-4
		W, see ^{115}Sb	1E-9	------	------
51	Antimony-128 (10.4 min)	D, see ^{115}Sb	5E-7	------	------
		St wall	------	1E-3	1E-2
		W, see ^{115}Sb	6E-7	------	------
51	Antimony-128 (9.01 h)	D, see ^{115}Sb	6E-9	2E-5	2E-4
		W, see ^{115}Sb	5E-9	------	------
51	Antimony-129	D, see ^{115}Sb	1E-8	4E-5	4E-4
		W, see ^{115}Sb	1E-8	------	------
51	Antimony-130	D, see ^{115}Sb	9E-8	3E-4	3E-3
		W, see ^{115}Sb	1E-7	------	------
51	Antimony-131	D, see ^{115}Sb	------	------	------
		Thyroid	6E-8	2E-4	2E-3
		W, see ^{115}Sb		------	------
		Thyroid	6E-8	------	------
52	Tellurium-116	D, all compounds except those given for W	3E-8	1E-4	1E-3
		W, oxides, hydroxides, and nitrates	4E-8	------	------
52	Tellurium-121m	D, see ^{116}Te	------	------	------
		Bone surf	5E-10	1E-5	1E-4
		W, see ^{116}Te	6E-10	------	------
52	Tellurium-121	D, see ^{116}Te	6E-9	4E-5	4E-4
		W, see ^{116}Te	4E-9	------	------
52	Tellurium-123m	D, see ^{116}Te	------	------	------
		Bone surf	8E-10	1E-5	1E-4
		W, see ^{116}Te	8E-10	------	------
52	Tellurium-123	D, see ^{116}Te	------	------	------
		Bone surf	7E-10	2E-5	2E-4
		W, see ^{116}Te	------	------	------
		Bone surf	2E-9	------	------

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52	Tellurium-125m	D, see ^{116}Te	------	------	------
		Bone surf	1E-9	2E-5	2E-4
		W, see ^{116}Te	1E-9	------	------
52	Tellurium-127m	D, see ^{116}Te	------	9E-6	9E-5
		Bone surf	6E-10	------	------
		W, see ^{116}Te	4E-10	------	------
52	Tellurium-127	D, see ^{116}Te	3E-8	1E-4	1E-3
		W, see ^{116}Te	2E-8	------	------
52	Tellurium-129m	D, see ^{116}Te	9E-10	7E-6	7E-5
		W, see ^{116}Te	3E-10	------	------
52	Tellurium-129	D, see ^{116}Te	9E-8	4E-4	4E-3
		W, see ^{116}Te	1E-7	------	------
52	Tellurium-131m	D, see ^{116}Te	------	------	------
		Thyroid	2E-9	8E-6	8E-5
		W, see ^{116}Te	------	------	------
		Thyroid	1E-9	------	------
52	Tellurium-131	D, see ^{116}Te	------	------	------
		Thyroid	2E-8	8E-5	8E-4
		W, see ^{116}Te	------	------	------
		Thyroid	2E-8	------	------
52	Tellurium-132	D, see ^{116}Te	------	------	------
		Thyroid	1E-9	9E-6	9E-5
		W, see ^{116}Te	------	------	------
		Thyroid	9E-10	------	------
52	Tellurium-133m	D, see ^{116}Te	------	------	------
		Thyroid	2E-8	9E-5	9E-4
		W, see ^{116}Te	------	------	------
		Thyroid	2E-8	------	------
52	Tellurium-133	D, see ^{116}Te	------	------	------
		Thyroid	8E-8	4E-4	4E-3
		W, see ^{116}Te	------	------	------
		Thyroid	8E-8	------	------
52	Tellurium-134	D, see ^{116}Te	------	------	------
		Thyroid	7E-8	3E-4	3E-3
		W, see ^{116}Te	------	------	------
		Thyroid	7E-8	------	------
53	Iodine-120m	D, all compounds	3E-8	------	------
		Thyroid	------	2E-4	2E-3
53	Iodine-120	D, all compounds	------	------	------
		Thyroid	2E-8	1E-4	1E-3
53	Iodine-121	D, all compounds	------	------	------
		Thyroid	7E-8	4E-4	4E-3
53	Iodine-123	D, all compounds	------	------	------
		Thyroid	2E-8	1E-4	1E-3
53	Iodine-124	D, all compounds	------	------	------
		Thyroid	4E-10	2E-6	2E-5

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53	Iodine-125	D, all compounds	------	------	------
		Thyroid	3E-10	2E-6	2E-5
53	Iodine-126	D, all compounds	------	------	------
		Thyroid	2E-10	1E-6	1E-5
53	Iodine-128	D, all compounds	2E-7	------	------
		St wall	------	8E-4	8E-3
53	Iodine-129	D, all compounds	------	------	------
		Thyroid	4E-11	2E-7	2E-6
53	Iodine-130	D, all compounds	------	------	------
		Thyroid	3E-9	2E-5	2E-4
53	Iodine-131	D, all compounds	------	------	------
		Thyroid	2E-10	1E-6	1E-5
53	Iodine-132m	D, all compounds	------	------	------
		Thyroid	3E-8	1E-4	1E-3
53	Iodine-132	D, all compounds	------	------	------
		Thyroid	2E-8	1E-4	1E-3
53	Iodine-133	D, all compounds	------	------	------
		Thyroid	1E-9	7E-6	7E-5
53	Iodine-134	D, all compounds	6E-8	------	------
		Thyroid	------	4E-4	4E-3
53	Iodine-135	D, all compounds	------	------	------
		Thyroid	6E-9	3E-5	3E-4
54	Xenon-120	Submersion[a/]	4E-8	------	------
54	Xenon-121	Submersion[a/]	1E-8	------	------
54	Xenon-122	Submersion[a/]	3E-7	------	------
54	Xenon-123	Submersion[a/]	3E-8	------	------
54	Xenon-125	Submersion[a/]	7E-8	------	------
54	Xenon-127	Submersion[a/]	6E-8	------	------
54	Xenon-129m	Submersion[a/]	9E-7	------	------
54	Xenon-131m	Submersion[a/]	2E-6	------	------
54	Xenon-133m	Submersion[a/]	6E-7	------	------
54	Xenon-133	Submersion[a/]	5E-7	------	------
54	Xenon-135m	Submersion[a/]	4E-8	------	------
54	Xenon-135	Submersion[a/]	7E-8	------	------
54	Xenon-138	Submersion[a/]	2E-8	------	------
55	Cesium-125	D, all compounds	2E-7	------	------
		St wall	------	1E-3	1E-2

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55	Cesium-127	D, all compounds	1E-7	9E-4	9E-3
55	Cesium-129	D, all compounds	5E-8	3E-4	3E-3
55	Cesium-130	D, all compounds	3E-7	------	------
		St wall	------	1E-3	1E-2
55	Cesium-131	D, all compounds	4E-8	3E-4	3E-3
55	Cesium-132	D, all compounds	6E-9	4E-5	4E-4
55	Cesium-134m	D, all compounds	2E-7	------	------
		St wall	------	2E-3	2E-2
55	Cesium-134	D, all compounds	2E-10	9E-7	9E-6
55	Cesium-135m	D, all compounds	3E-7	1E-3	1E-2
55	Cesium-135	D, all compounds	2E-9	1E-5	1E-4
55	Cesium-136	D, all compounds	9E-10	6E-6	6E-5
55	Cesium-137	D, all compounds	2E-10	1E-6	1E-5
55	Cesium-138	D, all compounds	8E-8	------	------
		St wall	------	4E-4	4E-3
56	Barium-126	D, all compounds	2E-8	8E-5	8E-4
56	Barium-128	D, all compounds	2E-9	7E-6	7E-5
56	Barium-131m	D, all compounds	2E-6	------	------
		St wall	------	7E-3	7E-2
56	Barium-131	D, all compounds	1E-8	4E-5	4E-4
56	Barium-133m	D, all compounds	1E-8	------	------
		LLI wall	------	4E-5	4E-4
56	Barium-133	D, all compounds	9E-10	2E-5	2E-4
56	Barium-135m	D, all compounds	2E-8	4E-5	4E-4
56	Barium-139	D, all compounds	4E-8	2E-4	2E-3
56	Barium-140	D, all compounds	2E-9	------	------
		LLI wall	------	8E-6	8E-5
56	Barium-141	D, all compounds	1E-7	3E-4	3E-3
56	Barium-142	D, all compounds	2E-7	7E-4	7E-3
57	Lanthanum-131	D, all compounds except			
		those given for W	2E-7	6E-4	6E-3
		W, oxides and hydroxides	2E-7	------	------
57	Lanthanum-132	D, see ^{131}La	1E-8	4E-5	4E-4
		W, see ^{131}La	2E-8	------	------
57	Lanthanum-135	D, see ^{131}La	1E-7	5E-4	5E-3
		W, see ^{131}La	1E-7	------	------

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57	Lanthanum-137	D, see ^{131}La	------	2E-4	2E-3
		Liver	1E-10	------	------
		W, see ^{131}La	------	------	------
		Liver	4E-10	------	------
57	Lanthanum-138	D, see ^{131}La	5E-12	1E-5	1E-4
		W, see ^{131}La	2E-11	------	------
57	Lanthanum-140	D, see ^{131}La	2E-9	9E-6	9E-5
		W, see ^{131}La	2E-9	------	------
57	Lanthanum-141	D, see ^{131}La	1E-8	5E-5	5E-4
		W, see ^{131}La	2E-8	------	------
57	Lanthanum-142	D, see ^{131}La	3E-8	1E-4	1E-3
		W, see ^{131}La	5E-8	------	------
57	Lanthanum-143	D, see ^{131}La	1E-7	------	------
		St wall	------	5E-4	5E-3
		W, see ^{131}La	1E-7	------	------
58	Cerium-134	W, all compounds except those given for Y	1E-9	------	------
		LLI wall	------	8E-6	8E-5
		Y, oxides, hydroxides, and fluorides	9E-10	------	------
58	Cerium-135	W, see ^{134}Ce	5E-9	2E-5	2E-4
		Y, see ^{134}Ce	5E-9	------	------
58	Cerium-137m	W, see ^{134}Ce	6E-9	------	------
		LLI wall	------	3E-5	3E-4
		Y, see ^{134}Ce	5E-9	------	------
58	Cerium-137	W, see ^{134}Ce	2E-7	7E-4	7E-3
		Y, see ^{134}Ce	2E-7	------	------
58	Cerium-139	W, see ^{134}Ce	1E-9	7E-5	7E-4
		Y, see ^{134}Ce	9E-10	------	------
58	Cerium-141	W, see ^{134}Ce	1E-9	------	------
		LLI wall	------	3E-5	3E-4
		Y, see ^{134}Ce	8E-10	------	------
58	Cerium-143	W, see ^{134}Ce	3E-9	------	------
		LLI wall	------	2E-5	2E-4
		Y, see ^{134}Ce	2E-9	------	------
58	Cerium-144	W, see ^{134}Ce	4E-11	------	------
		LLI wall	------	3E-6	3E-5
		Y, see ^{134}Ce	2E-11	------	------
59	Praseodymium-136	W, all compounds except those given for Y	3E-7	------	------
		St wall	------	1E-3	1E-2
		Y, oxides, hydroxides, carbides, and fluorides	3E-7	------	------
59	Praseodymium-137	W, see ^{136}Pr	2E-7	5E-4	5E-3
		Y, see ^{136}Pr	2E-7	------	------
59	Praseodymium-138m	W, see ^{136}Pr	8E-8	1E-4	1E-3
		Y, see ^{136}Pr	6E-8	------	------

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59	Praseodymium-139	W, see ^{136}Pr	2E-7	6E-4	6E-3
		Y, see ^{136}Pr	2E-7	------	------
59	Praseodymium-142m	W, see ^{136}Pr	2E-7		1E-3
1E-2					
		Y, see ^{136}Pr	2E-7	------	------
59	Praseodymium-142	W, see ^{136}Pr	3E-9	1E-5	1E-4
		Y, see ^{136}Pr	3E-9	------	------
59	Praseodymium-143	W, see ^{136}Pr	1E-9	------	------
		LLI wall	------	2E-5	2E-4
		Y, see ^{136}Pr	9E-10	------	------
59	Praseodymium-144	W, see ^{136}Pr	2E-7	------	------
		St wall	------	6E-4	6E-3
		Y, see ^{136}Pr	2E-7	------	------
59	Praseodymium-145	W, see ^{136}Pr	1E-8	4E-5	4E-4
		Y, see ^{136}Pr	1E-8	------	------
59	Praseodymium-147	W, see ^{136}Pr	3E-7	------	------
		St wall	------	1E-3	1E-2
		Y, see ^{136}Pr	3E-7	------	------
60	Neodymium-136	W, all compounds except those given for Y	8E-8	2E-4	2E-3
		Y, oxides, hydroxides, carbides, and fluorides	8E-8	------	------
60	Neodymium-138	W, see ^{136}Nd	9E-9	3E-5	3E-4
		Y, see ^{136}Nd	7E-9	------	------
60	Neodymium-139m	W, see ^{136}Nd	2E-8	7E-5	7E-4
		Y, see ^{136}Nd	2E-8	------	------
60	Neodymium-139	W, see ^{136}Nd	5E-7	1E-3	1E-2
		Y, see ^{136}Nd	4E-7	------	------
60	Neodymium-141	W, see ^{136}Nd	1E-6	2E-3	2E-2
		Y, see ^{136}Nd	9E-7	------	------
60	Neodymium-147	W, see ^{136}Nd	1E-9	------	------
		LLI wall	------	2E-5	2E-4
		Y, see ^{136}Nd	1E-9	------	------
60	Neodymium-149	W, see ^{136}Nd	4E-8	1E-4	1E-3
		Y, see ^{136}Nd	3E-8	------	------
60	Neodymium-151	W, see ^{136}Nd	3E-7	9E-4	9E-3
		Y, see ^{136}Nd	3E-7	------	------
61	Promethium-141	W, all compounds except those given for Y	3E-7	------	------
		St wall	------	8E-4	8E-3
		Y, oxides, hydroxides, carbides, and fluorides	2E-7	------	------
61	Promethium-143	W, see ^{141}Pm	8E-10	7E-5	7E-4
		Y, see ^{141}Pm	1E-9	------	------
61	Promethium-144	W, see ^{141}Pm	2E-10	2E-5	2E-4
		Y, see ^{141}Pm	2E-10	------	------

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61	Promethium-145	W, see ^{141}Pm	------	1E-4	1E-3
		Bone surf	3E-10	------	------
		Y, see ^{141}Pm	3E-10	------	------
61	Promethium-146	W, see ^{141}Pm	7E-11	2E-5	2E-4
		Y, see ^{141}Pm	6E-11	------	------
61	Promethium-147	W, see ^{141}Pm	------	------	------
		LLI wall	3E-10	7E-5	7E-4
		Y, see ^{141}Pm	2E-10	------	------
61	Promethium-148m	W, see ^{141}Pm	4E-10	1E-5	1E-4
		Y, see ^{141}Pm	5E-10	------	------
61	Promethium-148	W, see ^{141}Pm	8E-10	------	------
		LLI wall	------	7E-6	7E-5
		Y, see ^{141}Pm	7E-10	------	------
61	Promethium-149	W, see ^{141}Pm	3E-9	------	------
		LLI wall	------	2E-5	2E-4
		Y, see ^{141}Pm	2E-9	------	------
61	Promethium-150	W, see ^{141}Pm	3E-8	7E-5	7E-4
		Y, see ^{141}Pm	2E-8	------	------
61	Promethium-151	W, see ^{141}Pm	5E-9	2E-5	2E-4
		Y, see ^{141}Pm	4E-9	------	------
62	Samarium-141m	W, all compounds	1E-7	4E-4	4E-3
62	Samarium-141	W, all compounds	2E-7	------	------
		St wall	------	8E-4	8E-3
62	Samarium-142	W, all compounds	4E-8	1E-4	1E-3
62	Samarium-145	W, all compounds	7E-10	8E-5	8E-4
62	Samarium-146	W, all compounds	------	------	------
		Bone surf	9E-14	3E-7	3E-6
62	Samarium-147	W, all compounds	------	------	------
		Bone surf	1E-13	4E-7	4E-6
62	Samarium-151	W, all compounds	------	------	------
		LLI wall	2E-10	2E-4	2E-3
62	Samarium-153	W, all compounds	4E-9	------	------
		LLI wall	------	3E-5	3E-4
62	Samarium-155	W, all compounds	3E-7	------	------
		St wall	------	1E-3	1E-2
62	Samarium-156	W, all compounds	1E-8	7E-5	7E4
63	Europium-145	W, all compounds	3E-9	2E-5	2E-4
63	Europium-146	W, all compounds	2E-9	1E-5	1E-4
63	Europium-147	W, all compounds	2E-9	4E-5	4E-4

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63	Europium-148	W, all compounds	5E-10	1E-5	1E-4
63	Europium-149	W, all compounds	4E-9	2E-4	2E-3
63	Europium-150 (12.62 h)	W, all compounds	1E-8	4E-5	4E-4
63	Europium-150 (34.2 y)	W, all compounds	3E-11	1E-5	1E-4
63	Europium-152m	W, all compounds	9E-9	4E-5	4E-4
63	Europium-152	W, all compounds	3E-11	1E-5	1E-4
63	Europium-154	W, all compounds	3E-11	7E-6	7E-5
63	Europium-155	W, all compounds	------	5E-5	5E-4
		Bone surf	2E-10	------	------
63	Europium-156	W, all compounds	6E-10	8E-6	8E-5
63	Europium-157	W, all compounds	7E-9	3E-5	3E-4
63	Europium-158	W, all compounds	8E-8	3E-4	3E-3
64	Gadolinium-145	D, all compounds except			
		those given for W	2E-7	------	------
		St wall	------	6E-4	6E-3
		W, oxides, hydroxides, and fluorides	2E-7	------	------
64	Gadolinium-146	D, see ^{145}Gd	2E-10	2E-5	2E-4
		W, see ^{145}Gd	4E-10	------	------
64	Gadolinium-147	D, see ^{145}Gd	6E-9	3E-5	3E-4
		W, see ^{145}Gd	5E-9	------	------
64	Gadolinium-149	D, see ^{145}Gd	3E-9	4E-5	4E-4
		W, see ^{145}Gd	3E-9	------	------
64	Gadolinium-151	D, see ^{145}Gd	------	9E-5	9E-4
		Bone surf	9E-10	------	------
		W, see ^{145}Gd	2E-9	------	------
64	Gadolinium-152	D, see ^{145}Gd	------	------	------
		Bone surf	3E-14	4E-7	4E-6
		W, see ^{145}Gd	------	------	------
		Bone surf	1E-13	------	------
64	Gadolinium-153	D, see ^{145}Gd	------	6E-5	6E-4
		Bone surf	3E-10	------	------
		W, see ^{145}Gd	8E-10	------	------
64	Gadolinium-159	D, see ^{145}Gd	1E-8	4E-5	4E-4
		W, see ^{145}Gd	8E-9	------	------
65	Terbium-147	W, all compounds	5E-8	1E-4	1E-3
65	Terbium-149	W, all compounds	1E-9	7E-5	7E-4
65	Terbium-150	W, all compounds	3E-8	7E-5	7E-4

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65	Terbium-151	W, all compounds	1E-8	5E-5	5E-4
65	Terbium-153	W, all compounds	1E-8	7E-5	7E-4
65	Terbium-154	W, all compounds	6E-9	2E-5	2E-4
65	Terbium-155	W, all compounds	1E-8	8E-5	8E-4
65	Terbium-156m (5.0 h)	W, all compounds	4E-8	2E-4	2E-3
65	Terbium-156m (24.4 h)	W, all compounds	1E-8	1E-4	1E-3
65	Terbium-156	W, all compounds	2E-9	1E-5	1E-4
65	Terbium-157	W, all compounds	------	------	------
		LLI wall	8E-10	7E-4	7E-3
65	Terbium-158	W, all compounds	3E-11	2E-5	2E-4
65	Terbium-160	W, all compounds	3E-10	1E-5	1E-4
65	Terbium-161	W, all compounds	2E-9	------	------
		LLI wall	------	3E-5	3E-4
66	Dysprosium-155	W, all compounds	4E-8	1E-4	1E-3
66	Dysprosium-157	W, all compounds	9E-8	3E-4	3E-3
66	Dysprosium-159	W, all compounds	3E-9	2E-4	2E-3
66	Dysprosium-165	W, all compounds	6E-8	2E-4	2E-3
66	Dysprosium-166	W, all compounds	1E-9	------	------
		LLI wall	------	1E-5	1E-4
67	Holmium-155	W, all compounds	2E-7	6E-4	6E-3
67	Holmium-157	W, all compounds	2E-6	4E-3	4E-2
67	Holmium-159	W, all compounds	1E-6	3E-3	3E-2
67	Holmium-161	W, all compounds	6E-7	1E-3	1E-2
67	Holmium-162m	W, all compounds	4E-7	7E-4	7E-3
67	Holmium-162	W, all compounds	3E-6	------	------
		St wall	------	1E-2	1E-1
67	Holmium-164m	W, all compounds	4E-7	1E-3	1E-2
67	Holmium-164	W, all compounds	9E-7	------	------
		St wall	------	3E-3	3E-2
67	Holmium-166m	W, all compounds	9E-12	9E-6	9E5
67	Holmium-166	W, all compounds	2E-9	------	------
		LLI wall	------	1E-5	1E-4
67	Holmium-167	W, all compounds	8E-8	2E-4	2E-3
68	Erbium-161	W, all compounds	9E-8	2E-4	2E-3

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68	Erbium-165	W, all compounds	3E-7	9E-4	9E-3
68	Erbium-169	W, all compounds	4E-9	------	------
		LLI wall	------	5E-5	5E-4
68	Erbium-171	W, all compounds	1E-8	5E-5	5E-4
68	Erbium-172	W, all compounds	2E-9	------	------
		LLI wall	------	2E-5	2E-4
69	Thulium-162	W, all compounds	4E-7	------	------
		St wall	------	1E-3	1E-2
69	Thulium-166	W, all compounds	2E-8	6E-5	6E-4
69	Thulium-167	W, all compounds	3E-9	------	------
		LLI wall	------	3E-5	3E-4
69	Thulium-170	W, all compounds	3E-10	------	------
		LLI wall	------	1E-5	1E-4
69	Thulium-171	W, all compounds	------	------	------
		LLI wall	8E-10	2E-4	2E-3
69	Thulium-172	W, all compounds	2E-9	------	------
		LLI wall	------	1E-5	1E-4
69	Thulium-173	W, all compounds	2E-8	6E-5	6E-4
69	Thulium-175	W, all compounds	4E-7	------	------
		St wall	------	1E-3	1E-2
70	Ytterbium-162	W, all compounds except those given for Y	4E-7	1E-3	1E-2
		Y, oxides, hydroxides, and fluorides	4E-7	------	------
70	Ytterbium-166	W, see ^{162}Yb	3E-9	2E-5	2E-4
		Y, see ^{162}Yb	3E-9	------	------
70	Ytterbium-167	W, see ^{162}Yb	1E-6	4E-3	4E-2
		Y, see ^{162}Yb	1E-6	------	------
70	Ytterbium-169	W, see ^{162}Yb	1E-9	2E-5	2E-4
		Y, see ^{162}Yb	1E-9	------	------
70	Ytterbium-175	W, see ^{162}Yb	5E-9	------	------
		LLI wall	------	4E-5	4E-4
		Y, see ^{162}Yb	5E-9	------	------
70	Ytterbium-177	W, see ^{162}Yb	7E-8	2E-4	2E-3
		Y, see ^{162}Yb	6E-8	------	------
70	Ytterbium-178	W, see ^{162}Yb	6E-8	2E-4	2E-3
		Y, see ^{162}Yb	5E-8	------	------
71	Lutetium-169	W, all compounds except those given for Y	6E-9	3E-5	3E-4
		Y, oxides, hydroxides, and fluorides	6E-9	------	------
71	Lutetium-170	W, see ^{169}Lu	3E-9	2E-5	2E-4
		Y, see ^{169}Lu	3E-9	------	------

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71	Lutetium-171	W, see ^{169}Lu	3E-9	3E-5	3E-4
		Y, see ^{169}Lu	3E-9	------	------
71	Lutetium-172	W, see ^{169}Lu	2E-9	1E-5	1E-4
		Y, see ^{169}Lu	2E-9	------	------
71	Lutetium-173	W, see ^{169}Lu	------	7E-5	7E-4
		Bone surf	6E-10	------	------
		Y, see ^{169}Lu	4E-10	------	------
71	Lutetium-174m	W, see ^{169}Lu	------	------	------
		LLI wall	5E-10	4E-5	4E-4
		Y, see ^{169}Lu	3E-10	------	------
71	Lutetium-174	W, see ^{169}Lu	------	7E-5	7E-4
		Bone surf	3E-10	------	------
		Y, see ^{169}Lu	2E-10	------	------
71	Lutetium-176m	W, see ^{169}Lu	3E-8	1E-4	1E-3
		Y, see ^{169}Lu	3E-8	------	------
71	Lutetium-176	W, see ^{169}Lu	------	1E-5	1E-4
		Bone surf	2E-11	------	------
		Y, see ^{169}Lu	1E-11	------	------
71	Lutetium-177m	W, see ^{169}Lu	------	1E-5	1E-4
		Bone surf	2E-10	------	------
		Y, see ^{169}Lu	1E-10	------	------
71	Lutetium-177	W, see ^{169}Lu	3E-9	------	------
		LLI wall	------	4E-5	4E-4
		Y, see ^{169}Lu	3E-9	------	------
71	Lutetium-178m	W, see ^{169}Lu	3E-7	------	------
		St wall	------	8E-4	8E-3
		Y, see ^{169}Lu	2E-7	------	------
71	Lutetium-178	W, see ^{169}Lu	2E-7	------	------
		St wall	------	6E-4	6E-3
		Y, see ^{169}Lu	2E-7	------	------
71	Lutetium-179	W, see ^{169}Lu	3E-8	9E-5	9E-4
		Y, see ^{169}Lu	3E-8	------	------
72	Hafnium-170	D, all compounds except those given for W	8E-9	4E-5	4E-4
		W, oxides, hydroxides, carbides, and nitrates	6E-9	------	------
72	Hafnium-172	D, see ^{170}Hf	------	2E-5	2E-4
		Bone surf	3E-11	------	------
		W, see ^{170}Hf	------	------	------
		Bone surf	8E-11	------	------
72	Hafnium-173	D, see ^{170}Hf	2E-8	7E-5	7E-4
		W, see ^{170}Hf	2E-8	------	------
72	Hafnium-175	D, see ^{170}Hf	------	4E-5	4E-4
		Bone surf	1E-9	------	------
		W, see ^{170}Hf	2E-9	------	------
72	Hafnium-177m	D, see ^{170}Hf	8E-8	3E-4	3E-3
		W, see ^{170}Hf	1E-7	------	------

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72	Hafnium-178m	D, see ^{170}Hf	------	3E-6	3E-5
		Bone surf	3E-12	------	------
		W, see ^{170}Hf	------	------	------
		Bone surf	1E-11	------	------
72	Hafnium-179m	D, see ^{170}Hf	------	1E-5	1E-4
		Bone surf	8E-10	------	------
		W, see ^{170}Hf	8E-10	------	------
72	Hafnium-180m	D, see ^{170}Hf	3E-8	1E-4	1E-3
		W, see ^{170}Hf	4E-8	------	------
72	Hafnium-181	D, see ^{170}Hf	------	2E-5	2E-4
		Bone surf	6E-10	------	------
		W, see ^{170}Hf	6E-10	------	------
72	Hafnium-182m	D, see ^{170}Hf	1E-7	5E-4	5E-3
		W, see ^{170}Hf	2E-7	------	------
72	Hafnium-182	D, see ^{170}Hf	------	------	------
		Bone surf	2E-12	5E-6	5E-5
		W, see ^{170}Hf	------	------	------
		Bone surf	1E-11	------	------
72	Hafnium-183	D, see ^{170}Hf	6E-8	3E-4	3E-3
		W, see ^{170}Hf	8E-8	------	------
72	Hafnium-184	D, see ^{170}Hf	1E-8	3E-5	3E-4
		W, see ^{170}Hf	9E-9	------	------
73	Tantalum-172	W, all compounds except those given for Y	2E-7	5E-4	5E-3
		Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	1E-7	------	------
73	Tantalum-173	W, see ^{172}Ta	3E-8	9E-5	9E-4
		Y, see ^{172}Ta	2E-8	------	------
73	Tantalum-174	W, see ^{172}Ta	1E-7	4E-4	4E-3
		Y, see ^{172}Ta	1E-7	------	------
73	Tantalum-175	W, see ^{172}Ta	2E-8	8E-5	8E-4
		Y, see ^{172}Ta	2E-8	------	------
73	Tantalum-176	W, see ^{172}Ta	2E-8	5E-5	5E-4
		Y, see ^{172}Ta	2E-8	------	------
73	Tantalum-177	W, see ^{172}Ta	3E-8	2E-4	2E-3
		Y, see ^{172}Ta	2E-8	------	------
73	Tantalum-178	W, see ^{172}Ta	1E-7	2E-4	2E-3
		Y, see ^{172}Ta	1E-7	------	------
73	Tantalum-179	W, see ^{172}Ta	8E-9	3E-4	3E-3
		Y, see ^{172}Ta	1E-9	------	------
73	Tantalum-180m	W, see ^{172}Ta	9E-8	3E-4	3E-3
		Y, see ^{172}Ta	8E-8	------	------

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73	Tantalum-180	W, see ^{172}Ta	6E-10	2E-5	2E-4
		Y, see ^{172}Ta	3E-11	------	------
73	Tantalum-182m	W, see ^{172}Ta	8E-7	------	------
		St wall	------	3E-3	3E-2
		Y, see ^{172}Ta	6E-7	------	------
73	Tantalum-182	W, see ^{172}Ta	5E-10	1E-5	1E-4
		Y, see ^{172}Ta	2E-10	------	------
73	Tantalum-183	W, see ^{172}Ta	2E-9	------	------
		LLI wall	------	2E-5	2E-4
		Y, see ^{172}Ta	1E-9	------	------
73	Tantalum-184	W, see ^{172}Ta	8E-9	3E-5	3E-4
		Y, see ^{172}Ta	7E-9	------	------
73	Tantalum-185	W, see ^{172}Ta	1E-7	4E-4	4E-3
		Y, see ^{172}Ta	9E-8	------	------
73	Tantalum-186	W, see ^{172}Ta	3E-7	------	------
		St wall	------	1E-3	1E-2
		Y, see ^{172}Ta	3E-7	------	------
74	Tungsten-176	D, all compounds	7E-8	1E-4	1E-3
74	Tungsten-177	D, all compounds	1E-7	3E-4	3E-3
74	Tungsten-178	D, all compounds	3E-8	7E-5	7E-4
74	Tungsten-179	D, all compounds	2E-6	7E-3	7E-2
74	Tungsten-181	D, all compounds	5E-8	2E-4	2E-3
74	Tungsten-185	D, all compounds	9E-9	------	------
		LLI wall	------	4E-5	4E-4
74	Tungsten-187	D, all compounds	1E-8	3E-5	3E-4
74	Tungsten-188	D, all compounds	2E-9	------	------
		LLI wall	------	7E-6	7E-5
75	Rhenium-177	D, all compounds except those given for W	4E-7	------	------
		St wall	------	2E-3	2E-2
		W, oxides, hydroxides, and nitrates	5E-7	------	------
75	Rhenium-178	D, see ^{177}Re	4E-7	------	------
		St wall	------	1E-3	1E-2
		W, see ^{177}Re	4E-7	------	------
75	Rhenium-181	D, see ^{177}Re	1E-8	7E-5	7E-4
		W, see ^{177}Re	1E-8	------	------
75	Rhenium-182 (12.7 h)	D, see ^{177}Re	2E-8	9E-5	9E-4
		W, see ^{177}Re	2E-8	------	------
75	Rhenium-182 (64.0 h)	D, see ^{177}Re	3E-9	2E-5	2E-4
		W, see ^{177}Re	3E-9	------	-----
75	Rhenium-184m	D, see ^{177}Re	4E-9	3E-5	3E-4
		W, see ^{177}Re	6E-10	------	------

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75	Rhenium-184	D, see ^{177}Re	5E-9	3E-5	3E-4
		W, see ^{177}Re	2E-9	------	------
75	Rhenium-186m	D, see ^{177}Re	------	------	------
		St wall	3E-9	2E-5	2E-4
		W, see ^{177}Re	2E-10	------	------
75	Rhenium-186	D, see ^{177}Re	4E-9	3E-5	3E-4
		W, see ^{177}Re	2E-9	------	------
75	Rhenium-187	D, see ^{177}Re	------	8E-3	8E-2
		St wall	1E-6	------	------
		W, see ^{177}Re	1E-7	------	------
75	Rhenium-188m	D, see ^{177}Re	2E-7	1E-3	1E-2
		W, see ^{177}Re	2E-7	------	------
75	Rhenium-188	D, see ^{177}Re	4E-9	2E-5	2E-4
		W, see ^{177}Re	4E-9	------	------
75	Rhenium-189	D, see ^{177}Re	7E-9	4E-5	4E-4
		W, see ^{177}Re	6E-9	------	------
76	Osmium-180	D, all compounds except those given for W and Y	5E-7	1E-3	1E-2
		W, halides and nitrates	7E-7	------	------
		Y, oxides and hydroxides	6E-7	------	------
76	Osmium-181	D, see ^{180}Os	6E-8	2E-4	2E-3
		W, see ^{180}Os	6E-8	------	------
		Y, see ^{180}Os	6E-8	------	------
76	Osmium-182	D, see ^{180}Os	8E-9	3E-5	3E-4
		W, see ^{180}Os	6E-9	------	------
		Y, see ^{180}Os	6E-9	------	------
76	Osmium-185	D, see ^{180}Os	7E-10	3E-5	------
		W, see ^{180}Os	1E-9	------	------
		Y, see ^{180}Os	1E-9	------	------
76	Osmium-189m	D, see ^{180}Os	3E-7	1E-3	1E-2
		W, see ^{180}Os	3E-7	------	------
		Y, see ^{180}Os	2E-7	------	------
76	Osmium-191m	D, see ^{180}Os	4E-8	2E-4	2E-3
		W, see ^{180}Os	3E-8	------	------
		Y, see ^{180}Os	2E-8	------	------
76	Osmium-191	D, see ^{180}Os	3E-9	------	------
		LLI wall	------	3E-5	3E-4
		W, see ^{180}Os	2E-9	------	------
		Y, see ^{180}Os	2E-9	------	------
76	Osmium-193	D, see ^{180}Os	6E-9	------	------
		LLI wall	------	2E-5	2E-4
		W, see ^{180}Os	4E-9	------	------
		Y, see ^{180}Os	4E-9	------	------
76	Osmium-194	D, see ^{180}Os	6E-11	------	------
		LLI wall	------	8E-6	8E-5
		W, see ^{180}Os	8E-11	------	------
		Y, see ^{180}Os	1E-11	------	------

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77	Iridium-182	D, all compounds except those given for W and Y	2E-7	------	------
		St wall	------	6E-4	6E-3
		W, halides, nitrates, and metallic iridium	2E-7	------	------
		Y, oxides and hydroxides	2E-7	------	------
77	Iridium-184	D, see ^{182}Ir	3E-8	1E-4	1E-3
		W, see ^{182}Ir	5E-8	------	------
		Y, see ^{182}Ir	4E-8	------	------
77	Iridium-185	D, see ^{182}Ir	2E-8	7E-5	7E-4
		W, see ^{182}Ir	2E-8	------	------
		Y, see ^{182}Ir	1E-8	------	------
77	Iridium-186	D, see ^{182}Ir	1E-8	3E-5	3E-4
		W, see ^{182}Ir	9E-9	------	------
		Y, see ^{182}Ir	8E-9	------	------
77	Iridium-187	D, see ^{182}Ir	5E-8	1E-4	1E-3
		W, see ^{182}Ir	4E-8	------	------
		Y, see ^{182}Ir	4E-8	------	------
77	Iridium-188	D, see ^{182}Ir	6E-9	3E-5	3E-4
		W, see ^{182}Ir	5E-9	------	------
		Y, see ^{182}Ir	5E-9	------	------
77	Iridium-189	D, see ^{182}Ir	7E-9	------	------
		LLI wall	------	7E-5	7E-4
		W, see ^{182}Ir	5E-9	------	------
		Y, see ^{182}Ir	5E-9	------	------
77	Iridium-190m	D, see ^{182}Ir	3E-7	2E-3	2E-2
		W, see ^{182}Ir	3E-7	------	------
		Y, see ^{182}Ir	3E-7	------	------
77	Iridium-190	D, see ^{182}Ir	1E-9	1E-5	1E-4
		W, see ^{182}Ir	1E-9	------	------
		Y, see ^{182}Ir	1E-9	------	------
77	Iridium-192m	D, see ^{182}Ir	1E-10	4E-5	4E-4
		W, see ^{182}Ir	3E-10	------	------
		Y, see ^{182}Ir	2E-11	------	------
77	Iridium-192	D, see ^{182}Ir	4E-10	1E-5	1E-4
		W, see ^{182}Ir	6E-10	------	------
		Y, see ^{182}Ir	3E-10	------	------
77	Iridium-194m	D, see ^{182}Ir	1E-10	9E-6	9E-5
		W, see ^{182}Ir	2E-10	------	------
		Y, see ^{182}Ir	1E-10	------	------
77	Iridium-194	D, see ^{182}Ir	4E-9	1E-5	1E-4
		W, see ^{182}Ir	3E-9	------	------
		Y, see ^{182}Ir	3E-9	------	------
77	Iridium-195m	D, see ^{182}Ir	3E-8	1E-4	1E-3
		W, see ^{182}Ir	4E-8	------	------
		Y, see ^{182}Ir	3E-8	------	------
77	Iridium-195	D, see ^{182}Ir	6E-8	2E-4	2E-3
		W, see ^{182}Ir	7E-8	------	------
		Y, see ^{182}Ir	6E-8	------	------

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78	Platinum-186	D, all compounds	5E-8	2E-4	2E-3
78	Platinum-188	D, all compounds	2E-9	2E-5	2E-4
78	Platinum-189	D, all compounds	4E-8	1E-4	1E-3
78	Platinum-191	D, all compounds	1E-8	5E-5	5E-4
78	Platinum-193m	D, all compounds	8E-9	------	------
		LLI wall	------	4E-5	4E-4
78	Platinum-193	D, all compounds	3E-8	------	------
		LLI wall	------	6E-4	6E-3
78	Platinum-195m	D, all compounds	6E-9	------	------
		LLI wall	------	3E-5	3E-4
78	Platinum-197m	D, all compounds	6E-8	2E-4	2E-3
78	Platinum-197	D, all compounds	1E-8	4E-5	4E-4
78	Platinum-199	D, all compounds	2E-7	7E-4	7E-3
78	Platinum-200	D, all compounds	5E-9	2E-5	2E-4
79	Gold-193	D, all compounds except hose given for W and Y	4E-8	1E-4	1E-3
		W, halides and nitrates	3E-8	------	------
		Y, oxides and hydroxides	3E-8	------	------
79	Gold-194	D, see ^{193}Au	1E-8	4E-5	4E-4
		W, see ^{193}Au	8E-9	------	------
		Y, see ^{193}Au	7E-9	------	------
79	Gold-195	D, see ^{193}Au	2E-8	7E-5	7E-4
		W, see ^{193}Au	2E-9	------	------
		Y, see ^{193}Au	6E-10	------	------
79	Gold-198m	D, see ^{193}Au	4E-9	1E-5	1E-4
		W, see ^{193}Au	2E-9	------	------
		Y, see ^{193}Au	2E-9	------	------
79	Gold-198	D, see ^{193}Au	5E-9	2E-5	2E-4
		W, see ^{193}Au	3E-9	------	------
		Y, see ^{193}Au	2E-9	------	------
79	Gold-199	D, see ^{193}Au	1E-8	------	------
		LLI wall	------	4E-5	4E-4
		W, see ^{193}Au	6E-9	------	------
		Y, see ^{193}Au	5E-9	------	------
79	Gold-200m	D, see ^{193}Au	5E-9	2E-5	2E-4
		W, see ^{193}Au	4E-9	------	------
		Y, see ^{193}Au	3E-9	------	------
79	Gold-200	D, see ^{193}Au	9E-8	4E-4	4E-3
		W, see ^{193}Au	1E-7	------	------
		Y, see ^{193}Au	1E-7	------	------
79	Gold-201	D, see ^{193}Au	3E-7	------	------
		St wall	------	1E-3	1E-2
		W, see ^{193}Au	3E-7	------	------
		Y, see ^{193}Au	3E-7	------	------

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80	Mercury-193m	Vapor	1E-8	------	------
		Organic D	2E-8	6E-5	6E-4
		D, sulfates	1E-8	4E-5	4E-4
		W, oxides, hydroxides, halides, nitrates, and sulfides	1E-8	------	------
80	Mercury-193	Vapor	4E-8	------	------
		Organic D	9E-8	3E-4	3E-3
		D, see ^{193m}Hg	6E-8	2E-4	2E-3
		W, see ^{193m}Hg	6E-8	------	------
80	Mercury-194	Vapor	4E-11	------	------
		Organic D	4E-11	2E-7	2E-6
		D, see ^{193m}Hg	6E-11	1E-5	1E-4
		W, see ^{193m}Hg	2E-10	------	------
80	Mercury-195m	Vapor	6E-9	------	------
		Organic D	8E-9	4E-5	4E-4
		D, see ^{193m}Hg	7E-9	3E-5	3E-4
		W, see ^{193m}Hg	5E-9	------	------
80	Mercury-195	Vapor	4E-8	------	------
		Organic D	6E-8	2E-4	2E-3
		D, see ^{193m}Hg	5E-8	2E-4	2E-3
		W, see ^{193m}Hg	5E-8	------	------
80	Mercury-197m	Vapor	7E-9	------	------
		Organic D	1E-8	5E-5	5E-4
		D, see ^{193m}Hg	1E-8	4E-5	4E-4
		W, see ^{193m}Hg	7E-9	------	------
80	Mercury-197	Vapor	1E-8	------	------
		Organic D	2E-8	9E-5	9E-4
		D, see ^{193m}Hg	2E-8	8E-5	8E-4
		W, see ^{193m}Hg	1E-8	------	------
80	Mercury-199m	Vapor	1E-7	------	------
		Organic D	2E-7	------	------
		St wall	------	1E-3	1E-2
		D, see ^{193m}Hg	2E-7	8E-4	8E-3
		W, see ^{193m}Hg	2E-7	------	------
80	Mercury-203	Vapor	1E-9	------	------
		Organic D	1E-9	7E-6	7E-5
		D, see ^{193m}Hg	2E-9	3E-5	3E-4
		W, see ^{193m}Hg	2E-9	------	------
81	Thallium-194m	D, all compounds	2E-7	------	------
		St wall	------	1E-3	1E-2
81	Thallium-194	D, all compounds	8E-7	------	------
		St wall	------	4E-3	4E-2
81	Thallium-195	D, all compounds	2E-7	9E-4	9E-3
81	Thallium-197	D, all compounds	2E-7	1E-3	1E-2
81	Thallium-198m	D, all compounds	8E-8	4E-4	4E-3
81	Thallium-198	D, all compounds	5E-8	3E-4	3E-3
81	Thallium-199	D, all compounds	1E-7	9E-4	9E-3

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81	Thallium-200	D, all compounds	2E-8	1E-4	1E-3
81	Thallium-201	D, all compounds	3E-8	2E-4	2E-3
81	Thallium-202	D, all compounds	7E-9	5E-5	5E-4
81	Thallium-204	D, all compounds	3E-9	2E-5	2E-4
82	Lead-195m	D, all compounds	3E-7	8E-4	8E-3
82	Lead-198	D, all compounds	9E-8	4E-4	4E-3
82	Lead-199	D, all compounds	1E-7	3E-4	3E-3
82	Lead-200	D, all compounds	9E-9	4E-5	4E-4
82	Lead-201	D, all compounds	3E-8	1E-4	1E-3
82	Lead-202m	D, all compounds	4E-8	1E-4	1E-3
82	Lead-202	D, all compounds	7E-11	2E-6	2E-5
82	Lead-203	D, all compounds	1E-8	7E-5	7E-4
82	Lead-205	D, all compounds	2E-9	5E-5	5E-4
82	Lead-209	D, all compounds	8E-8	3E-4	3E-3
82	Lead-210	D, all compounds	------	------	------
		Bone surf	6E-13	1E-8	1E-7
82	Lead-211	D, all compounds	9E-10	2E-4	2E-3
82	Lead-212	D, all compounds	5E-11	------	------
		Bone surf	------	2E-6	2E-5
82	Lead-214	D, all compounds	1E-9	1E-4	1E-3
83	Bismuth-200	D, nitrates	1E-7	4E-4	4E-3
		W, all other compounds	1E-7	------	------
83	Bismuth-201	D, see ^{200}Bi	4E-8	2E-4	2E-3
		W, see ^{200}Bi	5E-8	------	------
83	Bismuth-202	D, see ^{200}Bi	6E-8	2E-4	2E-3
		W, see ^{200}Bi	1E-7	------	------
83	Bismuth-203	D, see ^{200}Bi	9E-9	3E-5	3E-4
		W, see ^{200}Bi	9E-9	------	------
83	Bismuth-205	D, see ^{200}Bi	3E-9	2E-5	2E4
		W, see ^{200}Bi	2E-9	------	------
83	Bismuth-206	D, see ^{200}Bi	2E-9	9E-6	9E-5
		W, see ^{200}Bi	1E-9	------	------
83	Bismuth-207	D, see ^{200}Bi	2E-9	1E-5	1E-4
		W, see ^{200}Bi	5E-10	------	------
83	Bismuth-210m	D, see ^{200}Bi	------	------	------
		Kidneys	9E-12	8E-7	8E-6
		W, see ^{200}Bi	9E-13	------	------

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83	Bismuth-210	D, see ^{200}Bi	------	1E-5	1E-4
		Kidneys	5E-10	------	------
		W, see ^{200}Bi	4E-11	------	------
83	Bismuth-212	D, see ^{200}Bi	3E-10	7E-5	7E-4
		W, see ^{200}Bi	4E-10	------	------
83	Bismuth-213	D, see ^{200}Bi	4E-10	1E-4	1E-3
		W, see ^{200}Bi	5E-10	------	------
83	Bismuth-214	D, see ^{200}Bi	1E-9	------	------
		St wall	------	3E-4	3E-3
		W, see ^{200}Bi	1E-9	------	------
84	Polonium-203	D, all compounds except those given for W	9E-8	3E-4	3E-3
		W, oxides, hydroxides, and nitrates	1E-7	------	------
84	Polonium-205	D, see ^{203}Po	5E-8	3E-4	3E-3
		W, see ^{203}Po	1E-7	------	------
84	Polonium-207	D, see ^{203}Po	3E-8	1E-4	1E-3
		W, see ^{203}Po	4E-8	------	------
84	Polonium-210	D, see ^{203}Po	9E-13	4E-8	4E-7
		W, see ^{203}Po	9E-13	------	------
85	Astatine-207	D, halides	4E-9	8E-5	8E-4
		W	3E-9	------	------
85	Astatine-211	D, halides	1E-10	2E-6	2E-5
		W	8E-11	------	------
86	Radon-220	With daughters removed	2E-8	------	------
		With daughters present	3E-11	------	------
86	Radon-222	With daughters removed	1E-8	------	------
		With daughters present	1E-10	------	------
87	Francium-222	D, all compounds	6E-10	3E-5	3E-4
87	Francium-223	D, all compounds	1E-9	8E-6	8E-5
88	Radium-223	W, all compounds	9E-13	------	------
		Bone surf	------	1E-7	1E-6
88	Radium-224	W, all compounds	2E-12	------	------
		Bone surf	------	2E-7	2E-6
88	Radium-225	W, all compounds	9E-13	------	------
		Bone surf	------	2E-7	2E-6
88	Radium-226	W, all compounds	9E-13	------	-----
		Bone surf	------	6E-8	6E-7
88	Radium-227	W, all compounds	------	------	-----
		Bone surf	3E-8	3E-4	3E3
88	Radium-228	W, all compounds	2E-12	------	------
		Bone surf	------	6E-8	6E-7

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89	Actinium-224	D, all compounds except those given for W and Y	------	------	------
		LLI wall	5E-11	3E-5	3E-4
		W, halides and nitrates	7E-11	------	------
		Y, oxides and hydroxides	6E-11	------	------
89	Actinium-225	D, see ^{224}Ac	------	------	------
		LLI wall	7E-13	7E-7	7E-6
		W, see ^{224}Ac	9E-13	------	------
		Y, see ^{224}Ac	9E-13	------	------
89	Actinium-226	D, see ^{224}Ac	------	------	------
		LLI wall	5E-12	2E-6	2E-5
		W, see ^{224}Ac	7E-12	------	------
		Y, see ^{224}Ac	6E-12	------	------
89	Actinium-227	D, see ^{224}Ac	------	------	------
		Bone surf	1E-15	5E-9	5E-8
		W, see ^{224}Ac	------	------	------
		Bone surf	4E-15	------	------
		Y, see ^{224}Ac	6E-15	------	------
89	Actinium-228	D, see ^{224}Ac	------	3E-5	3E-4
		Bone surf	2E-11	------	------
		W, see ^{224}Ac	------	------	------
		Bone surf	8E-11	------	------
		Y, see ^{224}Ac	6E-11	------	------
90	Thorium-226	W, all compounds except those given for Y	2E-10	------	------
		St wall	------	7E-5	7E-4
		Y, oxides and hydroxides	2E-10	------	------
90	Thorium-227	W, see ^{226}Th	5E-13	2E-6	2E-5
		Y, see ^{226}Th	5E-13	------	------
90	Thorium-228	W, see ^{226}Th	------	------	------
		Bone surf	3E-14	2E-7	2E-6
		Y, see ^{226}Th	2E-14	------	------
90	Thorium-229	W, see ^{226}Th	------	------	------
		Bone surf	3E-15	2E-8	2E-7
		Y, see ^{226}Th	------	------	------
		Bone surf	4E-15	------	------
90	Thorium-230	W, see ^{226}Th	------	------	------
		Bone surf	2E-14	1E-7	1E-6
		Y, see ^{226}Th	------	------	------
		Bone surf	3E-14	------	------
90	Thorium-231	W, see ^{226}Th	9E-9	5E-5	5E-4
		Y, see ^{226}Th	9E-9	------	------
90	Thorium-232	W, see ^{226}Th	------	------	------
		Bone surf	4E-15	3E-8	3E-7
		Y, see ^{226}Th	------	------	------
		Bone surf	6E-15	------	------
90	Thorium-234	W, see ^{226}Th	3E-10	------	------
		LLI wall	------	5E-6	5E-5
		Y, see ^{226}Th	2E-10	------	------

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91	Protactinium-227	W, all compounds except			
		those given for Y	2E-10	5E-5	5E-4
		Y, oxides and hydroxides	1E-10	------	------
91	Protactinium-228	W, see ^{227}Pa	------	2E-5	2E-4
		Bone surf	3E-11	------	------
		Y, see ^{227}Pa	2E-11	------	------
91	Protactinium-230	W, see ^{227}Pa	7E-12	------	------
		Bone surf	------	1E-5	1E-4
		Y, see ^{227}Pa	5E-12	------	------
91	Protactinium-231	W, see ^{227}Pa	------	------	------
		Bone surf	6E-15	6E-9	6E-8
		Y, see ^{227}Pa	------	------	------
		Bone surf	8E-15	------	------
91	Protactinium-232	W, see ^{227}Pa	------	2E-5	2E-4
		Bone surf	8E-11	------	------
		Y, see ^{227}Pa	------	------	------
		Bone surf	1E-10	------	------
91	Protactinium-233	W, see ^{227}Pa	1E-9	------	------
		LLI wall	------	2E-5	2E-4
		Y, see ^{227}Pa	8E-10	------	------
91	Protactinium-234	W, see ^{227}Pa	1E-8	3E-5	3E-4
		Y, see ^{227}Pa	9E-9	------	------
92	Uranium-230	D, UF_6, UO_2F_2, UO_2,$(NO_3)_2$	------	------	------
		Bone surf	8E-13	8E-8	8E-7
		W, UO_3, UF_4, UCl_4	5E-13	------	------
		Y, UO_2, U_3O_8	4E-13	------	------
92	Uranium-231	D, see ^{230}U	1E-8	------	------
		LLI wall	------	6E-5	6E-4
		W, see ^{230}U	8E-9	------	------
		Y, see ^{230}U	6E-9	------	------
92	Uranium-232	D, see ^{230}U	------	------	------
		Bone surf	6E-13	6E-8	6E-7
		W, see ^{230}U	5E-13	------	------
		Y, see ^{230}U	1E-14	------	------
92	Uranium-233	D, see ^{230}U	------	------	------
		Bone surf	3E-12	3E-7	3E-6
		W, see ^{230}U	1E-12	------	------
		Y, see ^{230}U	5E-14	------	------
92	Uranium-234	D, see ^{230}U	------	------	------
		Bone surf	3E-12	3E-7	3E-6
		W, see ^{230}U	1E-12	------	------
		Y, see ^{230}U	5E-14	------	------
92	Uranium-235	D, see ^{230}U	------	------	------
		Bone surf	3E-12	3E-7	3E-6
		W, see ^{230}U	1E-12	------	------
		Y, see ^{230}U	6E-14	------	------

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92	Uranium-236	D, see ^{230}U	------	------	------
		Bone surf	3E-12	3E-7	3E-6
		W, see ^{230}U	1E-12	------	------
		Y, see ^{230}U	6E-14	------	------
92	Uranium-237	D, see ^{230}U	4E-9	------	------
		LLI wall	------	3E-5	3E-4
		W, see ^{230}U	2E-9	------	------
		Y, see ^{230}U	2E-9	------	------
92	Uranium-238	D, see ^{230}U	------	------	------
		Bone surf	3E-12	3E-7	3E-6
		W, see ^{230}U	1E-12	—	------
		Y, see ^{230}U	6E-14	------	------
92	Uranium-239	D, see ^{230}U	3E-7	9E-4	9E-3
		W, see ^{230}U	2E-7	------	------
		Y, see ^{230}U	2E-7	------	------
92	Uranium-240	D, see ^{230}U	5E-9	2E-5	2E-4
		W, see ^{230}U	4E-9	------	------
		Y, see ^{230}U	3E-9	------	------
92	Uranium-natural	D, see ^{230}U	------	------	------
		Bone surf	3E-12	3E-7	3E-6
		W, see ^{230}U	9E-13	------	------
		Y, see ^{230}U	9E-14	------	------
93	Neptunium-232	W, all compounds	------	2E-3	2E-2
		Bone surf	6E-9	------	------
93	Neptunium-233	W, all compounds	4E-6	1E-2	1E-1
93	Neptunium-234	W, all compounds	4E-9	3E-5	3E-4
93	Neptunium-235	W, all compounds	------	------	------
		Bone surf	2E-9	3E-4	3E-3
93	Neptunium-236 (1.15E+5 y)	W, all compounds	------	------	------
		Bone surf	8E-14	9E-8	9E-7
93	Neptunium-236 (22.5 h)	W, all compounds	------	------	------
		Bone surf	1E-10	5E-5	5E-4
93	Neptunium-237	W, all compounds	------	------	------
		Bone surf	1E-14	2E-8	2E-7
93	Neptunium-238	W, all compounds	------	2E-5	2E-4
		Bone surf	2E-10	------	------
93	Neptunium-239	W, all compounds	3E-9	------	------
		LLI wall	------	2E-5	2E-4
93	Neptunium-240	W, all compounds	1E-7	3E-4	3E-3
94	Plutonium-234	W, all compounds except PuO_2	3E-10	1E-4	1E-3
		Y, PuO_2	3E-10	------	------
94	Plutonium-235	W, see ^{234}Pu	4E-6	1E-2	1E1
		Y, see ^{234}Pu	3E-6	------	------

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94	Plutonium-236	W, see ^{234}Pu	------	------	------
		Bone surf	5E-14	6E-8	6E-7
		Y, see ^{234}Pu	6E-14	------	------
94	Plutonium-237	W, see ^{234}Pu	5E-9	2E-4	2E-3
		Y, see ^{234}Pu	4E-9	------	------
94	Plutonium-238	W, see ^{234}Pu	------	------	------
		Bone surf	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	2E-14	------	------
94	Plutonium-239	W, see ^{234}Pu	------	------	------
		Bone surf	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	------	------	------
		Bone surf	2E-14	------	------
94	Plutonium-240	W, see ^{234}Pu	------	------	------
		Bone surf	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	------	------	------
		Bone surf	2E-14	------	------
94	Plutonium-241	W, see ^{234}Pu	------	------	------
		Bone surf	8E-13	1E-6	1E-5
		Y, see ^{234}Pu	------	------	------
		Bone surf	1E-12	------	------
94	Plutonium-242	W, see ^{234}Pu	------	------	------
		Bone surf	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	------	------	------
		Bone surf	2E-14	------	------
94	Plutonium-243	W, see ^{234}Pu	5E-8	2E-4	2E-3
		Y, see ^{234}Pu	5E-8	------	------
94	Plutonium-244	W, see ^{234}Pu	------	------	------
		Bone surf	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	------	------	------
		Bone surf	2E-14	------	------
94	Plutonium-245	W, see ^{234}Pu	6E-9	3E-5	3E-4
		Y, see ^{234}Pu	6E-9	------	------
94	Plutonium-246	W, see ^{234}Pu	4E-10	------	------
		LLI wall	------	6E-6	6E-5
		Y, see ^{234}Pu	4E-10	------	------
95	Americium-237	W, all compounds	4E-7	1E-3	1E-2
95	Americium-238	W, all compounds	------	5E-4	5E-3
		Bone surf	9E-9	------	------
95	Americium-239	W, all compounds	2E-8	7E-5	7E-4
95	Americium-240	W, all compounds	4E-9	3E-5	3E-4
95	Americium-241	W, all compounds	------	------	------
		Bone surf	2E-14	2E-8	2E-7
95	Americium-242m	W, all compounds	------	------	------
		Bone surf	2E-14	2E-8	2E-7
95	Americium-242	W, all compounds	------	5E-5	5E-4
		Bone surf	1E-10	------	------

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95	Americium-243	W, all compounds	------	------	------
		Bone surf	2E-14	2E-8	2E-7
95	Americium-244m	W, all compounds	------	------	------
		St wall	1E-8	1E-3	1E-2
95	Americium-244	W, all compounds	------	4E-5	4E-4
		Bone surf	4E-10	------	------
95	Americium-245	W, all compounds	1E-7	4E-4	4E-3
95	Americium-246m	W, all compounds	3E-7	------	------
		St wall	------	8E-4	8E-3
95	Americium-246	W, all compounds	1E-7	4E-4	4E-3
96	Curium-238	W, all compounds	2E-9	2E-4	2E-3
96	Curium-240	W, all compounds	------	------	------
		Bone surf	9E-13	1E-6	1E-5
96	Curium-241	W, all compounds	------	2E-5	2E-4
		Bone surf	5E-11	------	------
96	Curium-242	W, all compounds	------	------	------
		Bone surf	4E-13	7E-7	7E-6
96	Curium-243	W, all compounds	------	------	------
		Bone surf	2E-14	3E-8	3E-7
96	Curium-244	W, all compounds	------	------	------
		Bone surf	3E-14	3E-8	3E-7
96	Curium-245	W, all compounds	------	------	------
		Bone surf	2E-14	2E-8	2E-7
96	Curium-246	W, all compounds	------	------	------
		Bone surf	2E-14	2E-8	2E-7
96	Curium-247	W, all compounds	------	------	------
		Bone surf	2E-14	2E-8	2E-7
96	Curium-248	W, all compounds	------	------	------
		Bone surf	4E-15	5E-9	5E-8
96	Curium-249	W, all compounds	------	7E-4	7E-3
		Bone surf	4E-8	------	------
96	Curium-250	W, all compounds	------	------	------
		Bone surf	8E-16	9E-10	9E-9
97	Berkelium-245	W, all compounds	2E-9	3E-5	3E-4
97	Berkelium-246	W, all compounds	4E-9	4E-5	4E-4
97	Berkelium-247	W, all compounds	------	------	------
		Bone surf	1E-14	2E-8	2E-7
97	Berkelium-249	W, all compounds	------	------	------
		Bone surf	5E-12	6E-6	6E-5
97	Berkelium-250	W, all compounds	------	1E-4	1E-3
		Bone surf	1E-9	------	------

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Atomic Number	Radionuclide	Class	Table 1 Effluent Concentrations Col. 1 Air (uCi/ml)	Table 1 Effluent Concentrations Col. 2 Water (uCi/ml)	Table 2 Releases to Sewers Monthly Ave. Concentration (uCi/ml)
98	Californium-244	W, all compounds except those given for Y	8E-10	------	------
		St wall	------	4E-4	4E-3
		Y, oxides and hydroxides	8E-10	------	------
98	Californium-246	W, see ^{244}Cf	1E-11	5E-6	5E-5
		Y, see ^{244}Cf	1E-11	------	------
98	Californium-248	W, see ^{244}Cf	------	------	------
		Bone surf	2E-13	2E-7	2E-6
		Y, see ^{244}Cf	1E-13	------	------
98	Californium-249	W, see ^{244}Cf	------	------	------
		Bone surf	1E-14	2E-8	2E-7
		Y, see ^{244}Cf	------	------	------
		Bone surf	2E-14	------	------
98	Californium-250	W, see ^{244}Cf	------	------	------
		Bone surf	3E-14	3E-8	3E-7
		Y, see ^{244}Cf	4E-14	------	------
98	Californium-251	W, see ^{244}Cf	------	------	------
		Bone surf	1E-14	2E-8	2E-7
		Y, see ^{244}Cf	------	------	------
		Bone surf	2E-14	------	------
98	Californium-252	W, see ^{244}Cf	------	------	------
		Bone surf	5E-14	7E-8	7E-7
		Y, see ^{244}Cf	5E-14	------	------
98	Californium-253	W, see ^{244}Cf	3E-12	------	------
		Bone surf	------	5E-6	5E-5
		Y, see ^{244}Cf	2E-12	------	------
98	Californium-254	W, see ^{244}Cf	3E-14	3E-8	3E-7
		Y, see ^{244}Cf	2E-14	------	------
99	Einsteinium-250	W, all compounds	------	6E-4	6E-3
		Bone surf	2E-9	------	------
99	Einsteinium-251	W, all compounds	------	1E-4	1E-3
		Bone surf	2E-9	------	------
99	Einsteinium-253	W, all compounds	2E-12	2E-6	2E-5
99	Einsteinium-254m	W, all compounds	1E-11	------	------
		LLI wall	------	4E-6	4E-5
99	Einsteinium-254	W, all compounds	------	------	------
		Bone surf	2E-13	2E-7	2E-6
100	Fermium-252	W, all compounds	2E-11	6E-6	6E-5
100	Fermium-253	W, all compounds	1E-11	1E-5	1E-4
100	Fermium-254	W, all compounds	1E-10	4E-5	4E-4
100	Fermium-255	W, all compounds	3E-11	7E-6	7E-5
100	Fermium-257	W, all compounds	------	------	------
		Bone surf	3E-13	5E-7	5E-6

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Atomic Number	Radionuclide	Class	Table 1 Effluent Concentrations Col. 1 Air (uCi/ml)	Table 1 Effluent Concentrations Col. 2 Water (uCi/ml)	Table 2 Releases to Sewers Monthly Ave. Concentration (uCi/ml)
101	Mendelevium-257	W, all compounds	------	1E-4	1E-3
		Bone surf	1E-10	------	------
101	Mendelevium-258	W, all compounds	------	------	------
		Bone surf	5E-13	6E-7	6E-6
-	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours	Submersion[a/]	1E-9	------	------
-	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours		1E-12	1E-8	1E-7
-	Any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which either the identity or the concentration of any radionuclide in the mixture is not known	. . . .	1E-15	2E-9	2E-8

Footnotes appear at the end of these tables.

Footnotes:

[a/] *"Submersion" means that values given are for submersion in a hemispherical semi-infinite cloud of airborne material.*

Note:

1. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this section are not present in the mixture, the effluent and sewage concentrations for the mixture are the lowest values specified in this section for any radionuclide that is not known to be absent from the mixture; or

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Atomic Number	Radionuclide	Class	Table 1 Effluent Concentrations Col. 1 Air (uCi/ml)	Col. 2 Water (uCi/ml)	Table 2 Releases to Sewers Monthly Ave. Concentration (uCi/ml)
If it is known that Ac-227-D,W,Y, Th-229-W,Y, Th-232-W,Y, Pa-231-W,Y, Cm-248-W, and Cm-250-W are not present			1E-14	—	—
If, in addition, it is known that Sm-146-W, Gd-148-D,W, Gd-152-D, Th-228-W,Y, Th-230-W,Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, U-Nat-Y, Np-236-W, Np-237-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-W,Y, Pu-240-W,Y, Pu-242-W,Y, Pu-244-W,Y, Am-241-W, Am-242m-W, Am-243-W, Cm-243-W, Cm-244-W, Cm-245-W, Cm-246-W, Cm-247-W, Bk-247-W, Cf-249-W,Y, Cf-250-W,Y, Cf-251-W,Y, Cf-252-W,Y, and Cf-254-W,Y are not present			1E-13	—	—
If, in addition, it is known that Sm-147-W, Gd-152-W, Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, U-Nat-W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-W,Y, Es-254-W, Fm-257-W, and Md-258-W are not present			1E-12	—	—
If, in addition it is known that Fe-60, Sr-90, Cd-113m, Cd-113, In-115, I-129, Cs-134, Sm-145, Sm-147, Gd-148, Gd-152, Hg-194 (organic), Bi-210m, Ra-223, Ra-224, Ra-225, Ac-225, Th-228, Th-230, U-233, U-234, U-235, U-236, U-238, U-Nat, Cm-242, Cf-248, Es-254, Fm-257, and Md-258 are not present			—	1E-6	1E-5

2. If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in the Appendix for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity").

Example: If radionuclides "A," "B," and "C" are present in concentrations C_A, C_B, and C_C, and if the applicable effluent concentrations (EC) are EC_A, EC_B, and EC_C, respectively, then the concentrations shall be limited so that the following relationship exists:

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SUBCHAPTER 13. REPORTS OF THEFTS AND RADIATION INCIDENTS

7:28-13.1 Reports of theft or loss [of radioactive materials]

A State licensee, radioactive materials registrant or registrant [The owner, from whose possession a theft or loss occurs] shall immediately notify the Department by telephone, telefax or telegraph of any theft or loss of any source of radiation including machine sources and any naturally occurring or accelerator produced radioactive material, including TENORM, in such quantities and under such circumstances that a substantial radiation hazard and/or contamination hazard may result.

7:28-13.2 Reportable radiation incidents

(a) A State licensee, radioactive materials registrant or registrant [The owner] shall immediately notify the Department by telephone, telefax or [and] telegraph of any radiation incident which may have caused or threatens to cause the following:

1. (No change.);

2. The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in the Appendix to N.J.A.C. 7:28-11, Table 1 [Section 6.5(a) (Average concentrations) of this Chapter Columns C and D], or prorated values if more than one isotope is released;

3. (No change.); or

4. (No change.).

(b) (No change.)

(c) A State licensee, radioactive materials registrant or registrant [The owner] shall notify the Department within 24 hours by telephone, telefax or [and] telegraph of any radiation incident which may have caused or threatens to cause the following:

1. (No change.);

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2. The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limit specified for such materials in the Appendix, Table 1 to N.J.A.C. 7:28-11 [Section 6.5(a) (Average concentrations) of this Chapter, Columns C and D], or prorated values if more than one isotope is released;

3. (No change.); or

4. (No change.).

(d) (No change.)

(e) A State licensee, radioactive materials registrant or registrant [The owner] shall notify the Department in writing within 30 days of the following:

1. Each exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit of Subchapter 6 (Permissible Dose Rates[d], Radiation Levels and Concentrations) of this Chapter, or of a State licensee's license;

2. (No change.)

3. Levels of radiation or concentrations of radioactivity, not involving exposure of any individual in excess of any applicable limit of Subchapter 6 (Permissible Dose Rates[d], Radiation Levels and Concentrations) of this Chapter, outside a controlled area in excess of ten times the limits of Section 6.2 (Radiation levels outside controlled areas) and Subchapter 11 (Disposal of Radioactive Materials) of this Chapter, or of a State licensee's license.

(f) (No change.)

(g) (No change.).